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GENITO-URINARY
SYPHILOLOGY

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A SYSTEM OF
GENITO-URINARY DISEASES
SYPHILOLOGY AND DERMATOLOGY.

BY VARIOUS AUTHORS.

EDITED BY

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VOL. I.—PART I.

GENITO-URINARY DISEASES

WITH NUMEROUS ILLUSTRATIONS.

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P R E F A C E .

THE genius of modern medical literature is clearly in the direction of division of labor and associated effort. The marked favor with which the numerous "Systems" and "Cyclopædias" which have appeared in recent years have been received by the profession would seem to show that the composite treatise represents the ideal method of bookmaking. In fact, co-operation is the essential condition of thoroughness and completeness in a work covering a wide range of subjects.

The field of research in every department of medicine has grown so large that it is hardly possible for any one individual to carefully sift from the mass of new material accumulated by the great body of workers the facts and opinions which represent a distinct advance in our knowledge, and have a definite and permanent value.

Especially is this true of the three associated departments of general medicine and surgery embraced in this System. The evolutionary requirements of these specialties demand a new and standard work which shall embody the numerous and important additions made to our knowledge of the subjects they embrace, and at the same time be sufficiently comprehensive to serve as a compendium of reference.

The editor has sought to attain this object by enlisting the co-operation of distinguished specialists, each of whom has been selected for his special fitness to write on the subject assigned, and which has been, as far as practicable, the subject of his choice. Especial effort was made, by clearly defining the ground each article was to cover, to avoid overlapping of subjects and useless repetition, and at the same time secure an organic unison of the completed work, thus making it, as nearly as possible, as coherent and connected as if written by one individual.

It was impressed upon each contributor that, while his article was to be written from his own independent standpoint, the work was designed to be, first of all, thoroughly practical, and adapted to the wants of the

general practitioner as well as the specialist. With this object in view it was recommended that the subjects of diagnosis and treatment should be presented fully and in a clear and practical light.

The authors are responsible for the views expressed in their respective articles, and to them is due the credit for whatever value the work may possess.

The editor assumes the responsibility of the general plan and arrangement of the work and the articles bearing his name.

In Volume I it will be observed that new material not ordinarily found in text-books on genito-urinary diseases, but of great practical interest and value, has been introduced; such as the chapters on Functional Disorders of Micturition and their Relation to Various Morbid States, the Diagnostic Significance of Pathological Modifications of the Urine, Urine-analysis, Uro-genital Tuberculosis, etc. In addition, the complete monographs on Endoscopy and Cystoscopy contain elaborate and exhaustive presentations of the latest knowledge respecting these valuable aids to diagnosis and treatment.

The idea of grouping Genito-urinary Diseases, Syphilis, and Skin Diseases as proper subjects of associated study had its origin in this country, and it seems eminently fitting that the fruitful results of this idea should be presented by American writers.

It was found necessary, in order to compress the volume within reasonable limits, to omit the extensive and very complete bibliographies which accompanied many of the articles.

It is due to the publishers to state that they have shown a commendable liberality in having executed in the best and most artistic manner the numerous illustrations which form an attractive feature of the work, and serve so valuable a purpose in the elucidation of the text.

NEW YORK, *December, 1892.*

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ANATOMY AND PHYSIOLOGY

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 - II. The ureters
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 - IV. The prostate gland
 - V. The penis
 - VI. The urethra
 - VII. The male perineum
 - VIII. The scrotum
 - IX. The testicles
- Spinal Cord

DISEASES OF THE PENIS

BY RAMON G. BRYAN

Sir, I have
to inform you

- Abnormalities of the penis
- Injuries to the penis
 - Wounds of the penis
 - Fracture of the penis
 - Dislocation of the penis
- Cutaneous affections
- Lymphatic affections
- Erysipelas of the penis
- Gangrene of the penis
- Tumors of the penis
 - Elephantiasis of the penis
 - Epotheloma of the penis
 - Method of treatment
- Morbidity conditions of
 - Phimosis
 - Circumcision
 - Paraphimosis
- Diseases of the glands
 - Balanitis and balanoposthitis
 - Diabetes mellitus
 - Herpes pruriginosus
 - Verrucae

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ANATOMY AND PHYSIOLOGY OF THE GENITO-URINARY ORGANS.

BY GEORGE WOOLSEY, M. D.

ALTHOUGH a correct knowledge of the anatomy of the genito-urinary organs is essential for accurate diagnosis and intelligent treatment of these parts, it has seemed best to the writer to confine the description in the following pages mainly to those points in the anatomy of the genito-urinary organs which may have some practical application in the succeeding chapters; consequently, it may be noticed that many minute details have been intentionally omitted.

I. THE KIDNEYS.

The KIDNEYS are situated deeply, one in either lumbar region, behind or outside of the peritonæum.

Form.—The form of the kidneys is that of an oval, flattened from before backward, thus presenting flattened convex anterior and posterior surfaces, a convex outer border and a shorter concave inner border, deeply notched in the middle by the hilum, thus giving the kidney its peculiar shape like a bean, and known as reniform. The hilum is placed at the posterior part of the middle of the anterior edge, and therefore the pelvis is best reached along the posterior surface. The upper and lower ends are convex and broader than the middle, and the upper end is broader than the lower. The left kidney is longer and also narrower than the right.

Color.—The color of the kidneys is a brownish red, with deeper purplish shading in the medulla.

Size.—The average kidney measures four and a half inches long, two and a half inches broad, by one and a quarter to one and a half inch thick. The average WEIGHT is about four and a half ounces in the male, and somewhat less in the female. The figures as to size and weight are subject to rather wide variations between two healthy subjects, or between the two kidneys of the same subject.

Surfaces.—The *anterior* surface is convex and flattened, and looks forward, outward, and slightly upward, owing to the fact that the upper

ends are nearer together. The *posterior* surface looks in the opposite direction, and is somewhat more flattened by the muscular mass on which it lies. The long convex outer *border* looks outward, backward, and slightly upward; the shorter concave inner border looks in the opposite

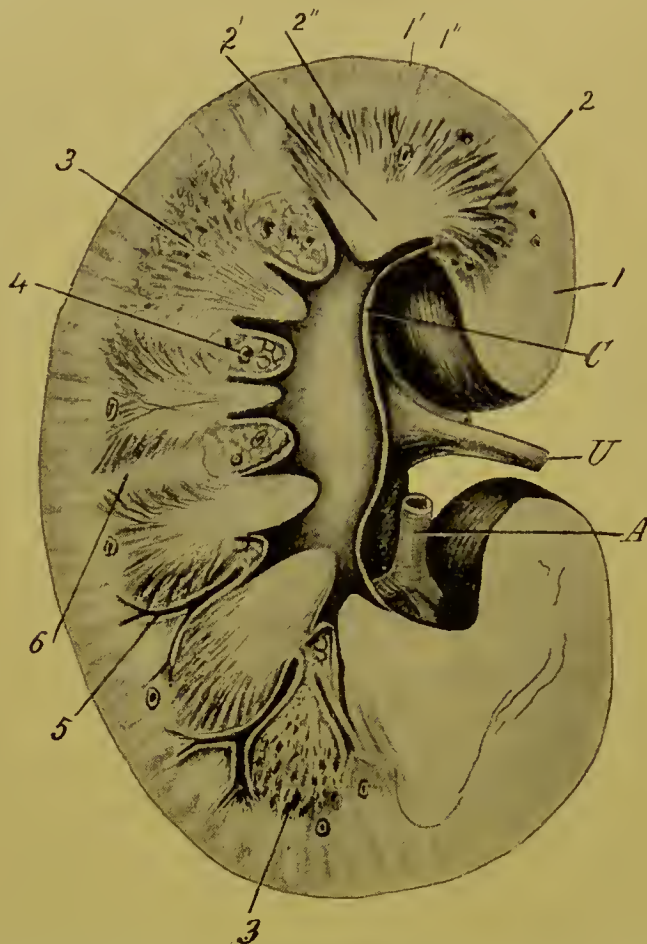


FIG. 1.—Frontal section through the kidney, pelvis, and calyces. *A*, branch of the renal artery; *U*, ureter; *C*, calyx; 1, cortex; 2', medulla; 2'', boundary zone; 4, fat of sinus of kidney; 5, arterial branches. (Henle.)

direction. The anterior border of the left kidney looks slightly more forward than that of the right.

The thicker, wider, rounded upper ends lie nearer one another, as has been mentioned, than the lower by the space of a quarter to half an inch; the upper ends also lie slightly more posteriorly.

Position.—The normal kidneys can not be distinctly felt, but are most accessible at the outer edge of the erector spinæ muscle below the last rib.

As to bony points, the kidney corresponds to the last dorsal and upper two and a half lumbar vertebræ. The *upper end* lies between the eleventh and twelfth ribs, or between the eleventh and twelfth dorsal vertebræ, and corresponds to the lower part of the tip of the spine of the eleventh dorsal vertebra.

The *lower end* is nearly opposite the lower part of the spine of the third lumbar vertebra and the middle of the third lumbar vertebra, or a vertebra higher than the crest of the ilium, above which, or the umbilicus the left kidney lies about two inches, the right kidney about one and a half to one and a quarter inch.

The hilum lies two inches from the middle line and between the first and second lumbar spines. The inner border lies nearly parallel to and about one inch from the spines of the lower two dorsal and upper three lumbar vertebræ. This border inclines slightly outward as it passes downward.

The outer border is two to two and a half inches external to the line of the inner border.

The upper end of the right kidney is lower than that of the left, owing to the position of the liver on the right side, but the lower end of the left

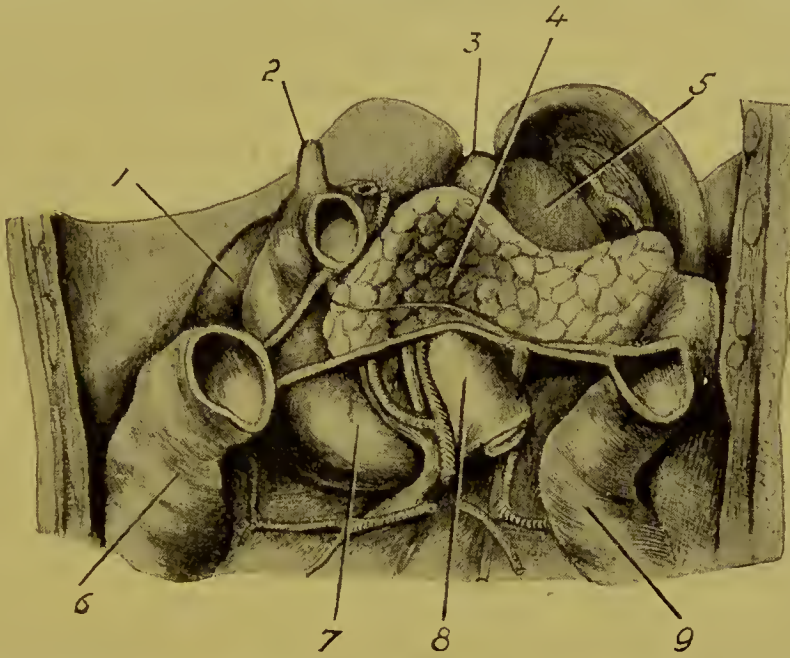


FIG. 2.—Relations of viscera (anterior view). 1, right kidney; 5, left kidney; 2 and 3, suprarenal capsules; 4, pancreas; 6 and 9, ascending and descending colon; 7, duodenum; 8, its junction with the jejunum. (Quain.)

kidney may reach as low as its fellow, owing to its greater length; the right, however, is usually lower.

The position of the kidneys under the liver and spleen makes enlargement of those organs cause displacement downward of the kidneys. Thus the hilum may be so lowered as to be opposite the fourth lumbar vertebra.

A pleuritic exudate may cause a similar displacement.

In the upright position the kidneys descend to a distinctly lower position than they occupy in the reclining position, and they descend still

lower on deep inspiration. These changes affect the right kidney rather more than the left. As the last rib is rudimentary, or is more like a transverse process, so as not to reach the border of the erector spinæ, in a considerable number of cases, it is always well to count the ribs before operating, in order to determine the position of the kidney.

The kidneys are separated from the vertebræ, on either side of which they lie, by the muscles in relation to them.

They lie almost equally on the diaphragm and the quadratus lumborum, the latter covered by the anterior layer of lumbar fascia; and, to a less extent, on the psoas magnus, which lies more especially in relation to the inner border of the kidney. It slightly overlaps the quadratus lumborum laterally, and here comes in contact with the posterior fascia of the transversalis muscle. The outer border of the quadratus corresponds to the middle of the crest of the ilium, at its attachment to that bone; but, as the muscle passes obliquely upward and inward at a point midway between the last rib and the iliac crest, the outer border of the muscle lies about an inch posterior or internal to a line drawn vertically up from this point of its attachment. On the *surface* of the body *anteriorly*, if a line be drawn vertically up from the middle of Poupart's ligament, one third of the kidney lies to the outer side of this line, the remaining two thirds to the inner or median side; and we have already seen that they do not quite reach, inferiorly, a horizontal line drawn through the umbilicus. Posteriorly its position, as indicated above, is one inch from the spines of the vertebræ, and between the spines of the eleventh dorsal and third lumbar vertebræ.

The position of the kidneys between the crest of the ilium and the lower ribs is such, that when the body is bent forwards the kidneys lie where the body is most sharply bent, and in this position they may sometimes be squeezed between the two bony margins.

Misplacements.—One, or, less often, both kidneys may be misplaced, the left more often than the right, and when it is misplaced it is often misshapen. It may be misplaced so as to lie over the sacro-iliac synchondrosis, the promontory of the sacrum, in the iliac fossa or in the pelvis.

Relations.—The kidney is in immediate relation to areolar tissue, called *tunica adiposa*, which envelops it, and is found most abundantly along the inner and outer borders, and more abundantly posteriorly than anteriorly. As it is largely owing to this investing *tunica adiposa* that the kidney retains its position, its presence and amount are matters of practical importance.

Thus, when this tissue, at one time abundant, is absorbed, owing to emaciation, a movable kidney is made possible. The amount of this *tunica adiposa* varies more or less with the fatness or leanness of the indi-

vidual, and may mislead one as to the size of the kidney. It is through this tissue that perinephritic abscesses extend, and inflammation in it may lead to adhesion with the fibrous capsule of the kidney, making it hard to expose the organ.

The relation of the kidneys to viscera varies more or less on the two sides ; the relation to muscles is practically the same on both sides. *An-*

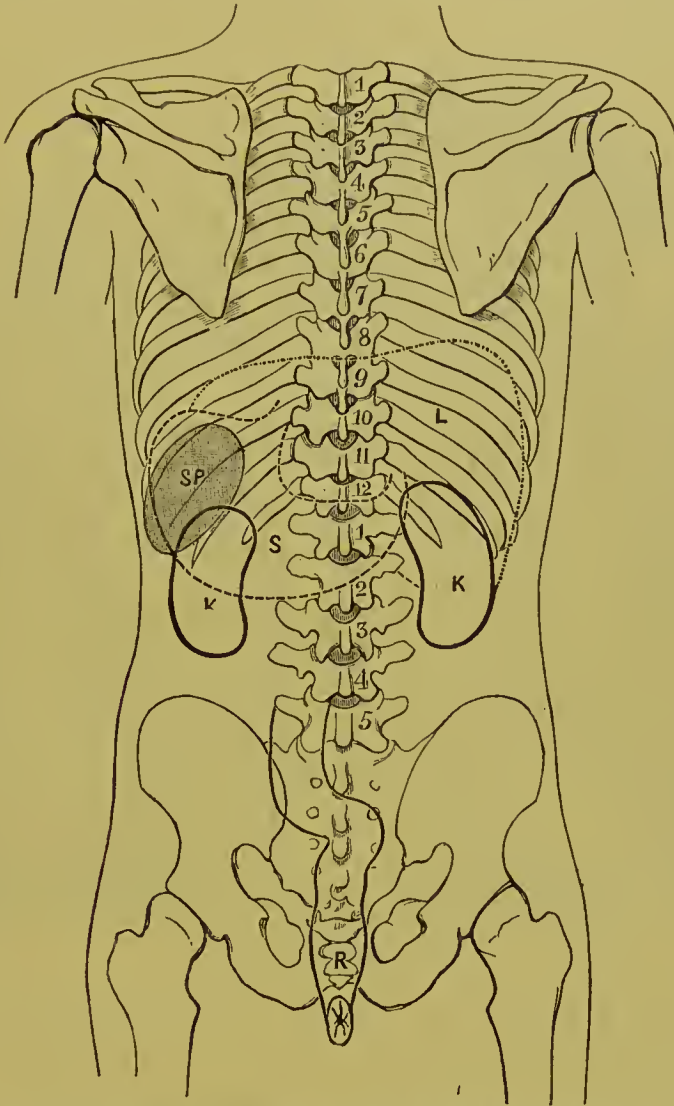


FIG. 3.—Diagram showing relation of the viscera to the parietes (posterior view). S, stomach ; L, liver ; K, kidney ; SP, spleen ; R, rectum. (Treves.)

teriorly the *right kidney* has at its upper part the right lobe of the liver ; lower down, and in front of the inner border, the second part of the duodenum ; and crossing the lower end obliquely from below upward, and from without inward, is the ascending colon. The colon passes farther upward in front of its inner aspect, where we find the commencement of the transverse colon.

The *left kidney* has in front of its upper end the fundus of the stomach separated by the lesser omentum; below this comes the pancreas, and descending vertically along the front of the outer margin is the descending colon. The left kidney has the spleen in contact with the upper two thirds of its outer border; while in many cases the right kidney has the head of the pancreas, embraced by the duodenum, in contact with the inner margin, though this relation is not usually spoken of. The *muscles* directly behind the kidneys have already been mentioned, in defining the

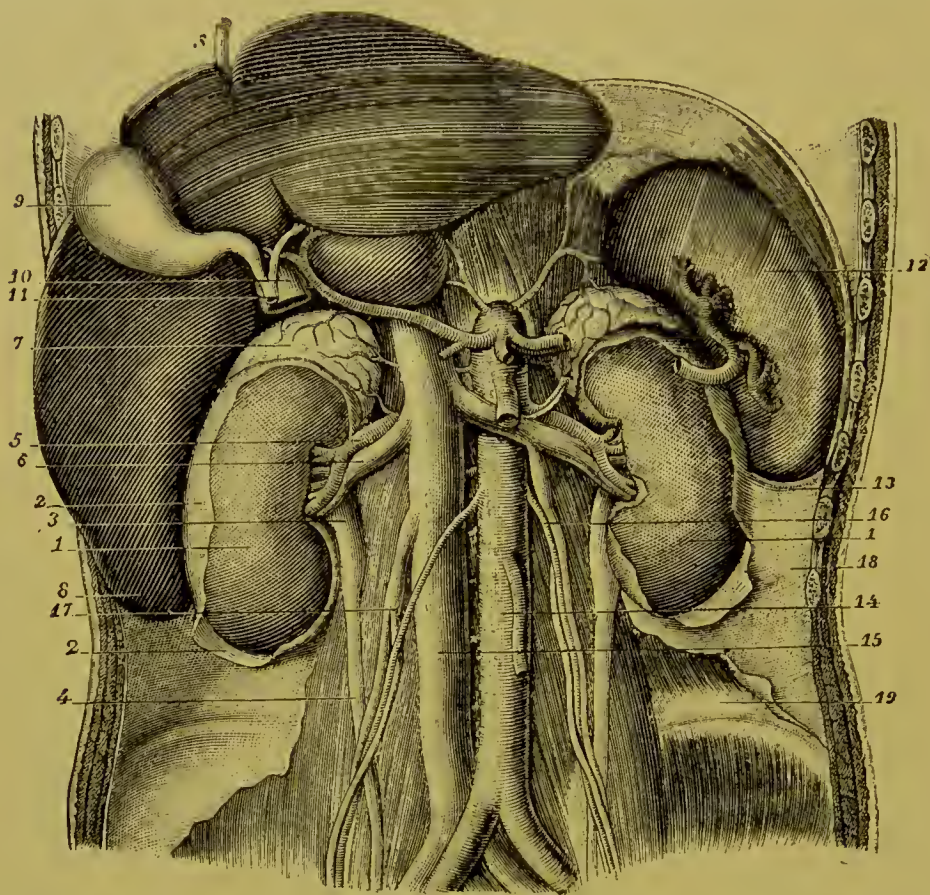


FIG. 4.—Situation, direction, form, relations of the kidneys. 1, 1, the two kidneys; 2, 2, fibrous capsule; 3, 3, pelvis; 4, 4, ureter; 5, 5, renal artery; 6, 6, renal vein; 7, 7, suprarenal capsule; 8, 8, the liver lifted up; 9, 9, gall bladder; 12, 12, spleen; 14, 14, abdominal aorta; 15, 15, inferior vena cava; 16, 16, left spermatic artery and vein. (Sappey.)

position of the organ. Posterior to the quadratus lumborum, and separated from it by the middle layer of the lumbar fascia, lies the erector spinæ muscle, forming the principal part of the muscular mass on either side of the spine. The outer edge of the erector spinæ lies internal to that of the quadratus lumborum, so that in operating through the lumbar regions the outer margin of both muscles form important landmarks. Internally both kidneys are in relation to the artery, vein, and ureter, which pass in or out at the hilum.

Relation to Peritonæum.—The peritonæum is in relation only with that portion of the anterior surface of the kidney which is not covered by viscera free of peritonæum. In over fifty per cent of cases the ascending and descending colons have no meso-colon, and are in direct contact with the kidney. Four fifths of the anterior surface of the right kidney and but two thirds of the left are covered by peritonæum; the rest of the surface is separated from peritonæum by the other viscera in contact. The peritonæum is readily stripped from the kidney. The distance between the lateral edge of the quadratus lumborum and the parietal peritonæum external to the kidney is less on the left side by at least one centimeter. The peritonæum helps to hold the kidneys in place, and in cases of movable kidney it is usually more or less stretched, to allow the movement to take place. In the congenital variety, or “floating kidney,” there is a complete peritoneal covering and a meso-nephron, the excursion of the kidney being only limited by the length of its pedicle.

Relation to Pleura.—That the lower *cul-de-sac* of the pleura lies behind the upper end of the kidney, may be inferred from their relative positions; for the lower limit of the pleura normally extends from the lower end of the last dorsal vertebra almost horizontally outward to the lower margin of the eleventh rib, and even with a normally developed twelfth rib the pleura may reach below its lower or inner border. With a rudimentary twelfth rib the pleura extends some distance below the last or eleventh rib, as the line of the pleura is the same as above. The lower end of the diaphragm is indicated, as we reach it by a lumbar incision from behind, by the line of the last dorsal nerve. Besides this nerve, we find, crossing the posterior surface of the kidney obliquely from above downward and outward, branches of the first lumbar artery and the ilio-hypogastric and ilio-inguinal nerves.

Structure.—The fibrous capsule of the kidney is a firm, thin, fibro-elastic membrane, smooth externally, and on being stripped off from the kidney, which is easily done with a healthy organ, the surface of the kidney and the inner surface of the capsule appear quite smooth, though the two are connected by a delicate reticulum of fibrous tissue and capillary vessels, continuous with the fibrous framework of the kidney. In certain diseases of the kidney accompanied by cirrhosis this reticulum is hypertrophied and the capsule is removed with difficulty, leaving a rough surface. The elastic fibers in the capsule give it the power of adapting itself to the size of the organ, varying according to the vascular tension. Under the capsule is a partial layer of plain muscle-fibers. By splitting the kidney longitudinally from its inner to its outer border, the notch on the inner border, known as the hilum, is found to lead into the substance of the organ, and there expand into an inclosed cavity known as the sinus.

The capsule, closely investing the tissue of the hilum, here passes in and lines the sinus of the kidney. Here around the bases of the papillæ it becomes continuous with the strong fibrous coat of the calyces. The solid substance of the organ is made up of cortical and medullary substance, the latter composed of from twelve to twenty pyramidal-shaped segments whose apices project into the sinus. They are separated from one another laterally by cortical substances dipping down between, and indicating the development of the kidney from as many segments as there are pyramids. This segmentation shows on the surface in the foetal kidney, and sometimes persists as a lobulation through life. The cortical substance, besides passing between and separating the pyramids, and here reaching the sinus, as the columnæ Bertini, forms a thin superficial shell from one sixth to one fourth of an inch thick, and lying immediately under the capsule.

The cortex is of a lightish red-brown color, soft in comparison to the medulla. The latter is much darker and purplish, except at the apices,

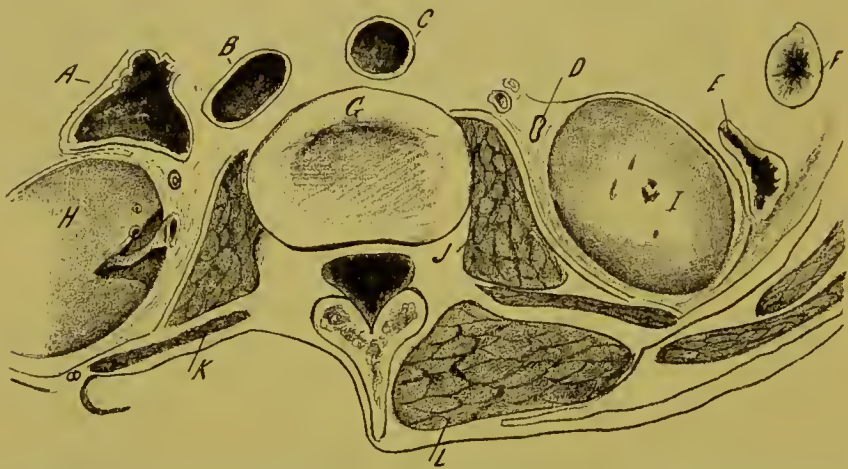


FIG. 5.—Horizontal section of body between second and third lumbar vertebra (surface of upper section). *H*, right kidney; *I*, left kidney; *D*, ureter. (Annals of Surgery.)

where the color is lighter, and it is distinctly striated owing to the diverging but nearly parallel tubules and blood-vessels. At the boundary between cortex and medulla bundles of tubules pass into the cortex, separated from other bundles, by cortical substance, and giving the appearance of rays radiating toward the surface and known as the medullary rays.

Excretory Apparatus.—On tracing up the ureter, we find that it begins to enlarge opposite the lower end of the kidney, and expands into a funnel-shaped dilatation, called the *pelvis*, which passes into the sinus through the hilum. Within the sinus the *pelvis* divides into three, or sometimes two, primary branches, which subdivide into a number of short, truncated pouches called *calyces*. The widened mouths of these calyces receive one or more papillæ. Consequently there are more papillæ than calyces, as

one calyx may correspond to as many as three papillæ. The calyces are too narrow to admit the finger for exploration. The outer fibrous coat of these calyces is continuous around the bases of the papillæ with the fibrous capsule of the kidney which, as we saw, passed in and lined the sinus. The circular muscular fibers of the ureter, pelvis, and calyces, end as a circular muscle around the base of the papillæ, while the longitudinal fibers are lost near the mouth of the calyx. The epithelium of the internal or mucous coat is reflected over the summit of the papillæ where it becomes continuous with the lining of the uriniferous tubules.

The sinus of the kidney is further occupied by the renal artery and vein and their primary branches, numerous lymphatics, and nerves; all imbedded in a quantity of connective tissue and fat, the fat separating and imbedding the other structures.

These structures, with the pelvis, form the so-called *pedicle* of the kidney, which assists in holding the kidney in position, and which must be ligated in the operation of nephrectomy.

As the various structures pass in or out at the hilum of the kidney they bear the following relations to one another: From before backward, vein, artery, and pelvis lie in the order named. From above downward, the pelvis has the lower position, the artery the upper. The vein is thus situated where it is least exposed to pressure.

Minute Structure.—If a papilla of a fresh kidney is squeezed, a little urine appears from many fine orifices on the surface. These are seen, with the aid of a lens, near the apex of the papilla, and are often found in large numbers at the bottom of a *foveola*, or shallow depression near the summit; or, more often, there are a number of small foveolæ over the surface.

These minute openings are the mouths of the uriniferous tubules, which, as we trace them toward the cortex, bifurcate repeatedly at acute angles. The number of tubules thus constantly increases toward the bases of the pyramids.

These tubules, known as *collecting tubes*, pass up through the boundary zone, between medulla and cortex, into the medullary rays, thence laterally into the cortical substance as a *junctional tubule*, beyond which is the *second convoluted tubule*, and then the *irregular tubule*. The tubule

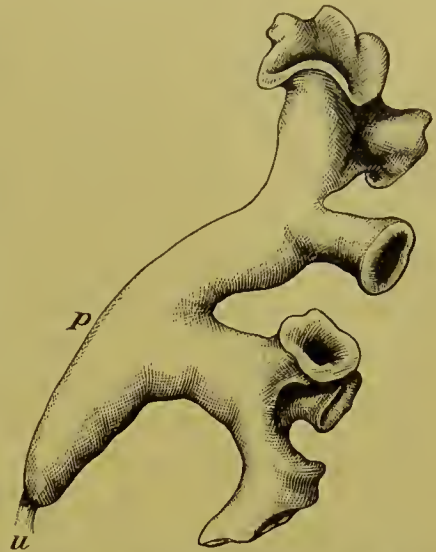


FIG. 6.—Cast of the pelvis and calyces. *u*, ureter; *p*, pelvis. (Henle.)

enters a medullary ray and, after passing down into the medulla, turns in a loop, known as "*Henle's looped tubule*," and passes up again into a medullary ray and out into the cortex as a *spiral tubule*, which is followed by the *first convoluted tubule*. This is separated by a narrowed neck from a dilatation, which is mostly occupied by a vascular, convoluted, capillary tuft, known as a *Malpighian tuft*. The tubules are lined by epithelium varying in different parts of the tubule. This lining is continued in the dilatation as a flattened layer which covers also the surface of the vascular tuft.

Blood-vessels.—The vessels are very large for the size of the kidneys. The renal artery, as large as the brachial, is given off from the aorta a little below the superior mesenteric artery, and passes nearly horizontally under the vena cava on the right side, to reach the hilum of the kidney, before entering which it divides into four or five branches. These pass in the cellular fatty tissue between the calyces, and, dividing and subdividing, reach the cortical substance on the surface of the sinus between the pyramids. In this cortical substance the arteries pass toward the surface until they reach the *boundary zone* between the cortex and medulla, where they turn to the side and form partial arches between the cortex and medulla.

From this arch smaller branches pass between the medullary rays toward the surface, and branches of these again break up into the capillary tufts above mentioned. Before joining the complete venous arches between the cortex and medulla these capillaries form an efferent vein, smaller than the afferent artery, as some of the fluid of the blood transudes through the Malpighian tuft. This efferent vein breaks up into a capillary network surrounding the various tubules.

The **veins** follow much the same course as the arteries, and, collecting into four or five trunks, pass out of the hilum, soon uniting into one, which, passing in front of the aorta on the left side, enters the inferior vena cava, receiving in its course the spermatic vein.

Nerves.—Both cerebro-spinal and sympathetic filaments enter the kidney accompanying the artery. They come from the renal plexus and lesser splanchnic nerve.

Lymphatics are numerous, and comprise a superficial set in or beneath the fibrous capsule of the kidney, communicating with a deeper set which accompany the blood-vessels.

The various structures of the kidney, thus briefly described, are bound together and supported by interstitial connective tissue, continuous by a fine reticulum, with the fibrous capsule as already mentioned.

Irregularities of the Renal Vessels.—This occurs in the arteries in over forty per cent of all cases, and may concern the origin, number, place of entrance into the kidney, branches to neighboring parts, etc. The num-

ber of arteries is more often increased than decreased, though a common origin of the two from the aorta has been observed. The origin of multiple arteries may be the aorta, suprarenal, lumbar, middle sacral, colica dextra, right hepatic, or one of the iliac arteries.

The usual place of entrance is at the hilum, but they may enter the kidney at either end or on either surface.

The neighboring parts which may receive branches from the kidney are the diaphragm, colon, pancreas, liver (right lobe), or testis.

The veins may also vary in number, places of emergence, etc.

Abnormities.—The two kidneys may be more or less completely fused together. The lowest degree is represented by the horseshoe kidney, where the two are joined at their lower parts across the median line by connective tissue or kidney substance. From this we may have all degrees of union up to complete fusion, along the inner borders, into a disk in the median line, with one or two pelves. Horseshoe kidneys occur once in 1,600 cases, single-fused kidneys once in 8,000. If a horseshoe kidney is joined by connective tissue, it offers no bar to operation. Entire absence of one kidney or extreme atrophy occurs as often as once in 4,000 cases. On the other hand, there may be three kidneys.

PHYSIOLOGY.

The physiology of the kidney, briefly stated, is as follows: In the Malpighian tufts by a process of filtration are separated most of the water and inorganic salts of the urine. The amount of the filtration depends upon the blood-pressure in the kidney. The urea and like bodies, with more or less water, etc., are derived by a true secreting action of the cells of the convoluted tubules. These separate elements mix in the tubules, and are propelled by the *vis a tergo* of the drops of fluid behind them. The circular muscle fibers around the bases of the pyramids may by their contraction have a milking action on the urine in the tubules of the pyramids. The drops of urine are collected in the calyces, and pass on to the pelvis and into the ureter.

II. THE URETERS.

The expanded pelvis passing out through the lower part of the hilum gradually tapers funnel-like, and becomes cylindrical opposite the lower end of the kidney. Thence, under the name of the ureter, it continues downward to the termination at the base of the bladder. The length is about fourteen to sixteen inches and the caliber about that of a large goose-quill, though often dilated especially at the lower end. The lumen varies; it is narrowest at its lower opening, and in its passage through the bladder wall it is narrower than above.

Course.—The course of the ureters is downward, converging slightly, to the brim of the pelvis near the sacro-iliae synchondrosis. Thence it passes downward, forward, and inward in the posterior false ligament of the bladder in a curve like that of the posterior pelvic wall, and lying nearly parallel to the lateral edges of the sacrum. It lies behind the peritonæum, and as it approaches the pelvis it is found in the angle between the bodies of the vertebræ and the psoas muscle.

Relations.—In this course the ureter is firmly adherent to the peritonæum at a point near the attachment of the latter to the spine, one half to one inch from this point on the left side, and a little more on the right side, where the ureter is displaced outward by the vena cava.

Consequently, we find in a section between the second and third lumbar vertebræ that the right ureter is four centimetres from the margin of the parietal peritonæum external to the outer border of the kidney; the left is six centimetres distant. The ureter lies on the psoas magnus muscle, crossing it and the genito-erural nerve obliquely, and only loosely connected with the muscle. It is crossed on either side in front by the spermatic or ovarian vessels. On the right side it lies external to and close to the inferior vena cava. Near the brim of the pelvis it commonly crosses on the left side the common iliac vessels behind the sigmoid flexure; on the right side the external iliac vessels behind the termination of the ileum.

In the posterior false ligament of the bladder the ureter lies near the attached margin of this fold and at the side of the fundus of the bladder. It is placed below the line of the obliterated hypogastric artery, and, in the male, the vas deferens arches over it here, between it and the bladder, and thus comes to lie internal to it. It enters the wall of the bladder about two inches from the opposite ureter, and passes for three quarters of an inch obliquely through the bladder wall, so that the two inner slit-like oblique openings are about one and a quarter to one and a half inch apart, and the same distance from the urethral orifice of the bladder.

In its passage through the bladder wall it lies mostly between the muscular and mucous coats, and the obliquity of its course through the bladder gives it a valve-like action.

In the female, the ureters pass on either side of, and three quarters of an inch from, the uterus and fundus of the vagina to reach the base of the bladder. For the last two inches or more they run in the broad ligament in close relation to the upper part of the vault of the vagina, through which they may be reached.

Structure.—The wall of the ureters is composed of three layers: 1, an outer fibrous layer containing some elastic fibers; 2, a middle layer of unstriped muscle-fiber consisting of an internal circular and an external longitudinal layer, with sometimes a circular layer outside the longitudi-

nal ; 3, internally a mucous membrane continuous above with the epithelium of the tubules of the kidney below, with that of the bladder, which it closely resembles. A few mucous glands are sometimes found scattered throughout the ureter, pelvis, and calyces, and in some cases small blunt papillæ are found in the lower part of the ureters when they also occur in the bladder. In the passage of the ureters through the muscular layer of the bladder wall its own muscle-fibers become directed in two ways : 1, transversely to join corresponding fibers of the other ureter : 2, obliquely downward to the floor of the urethra, where it meets those from the opposite ureter. The structure of the walls of the pelvis and calyces is identical with that of the ureter. The ureters may sometimes be dilated so as to be as large as the small intestine, but this is due to the accumulation of urine in them, and not to reflux from the bladder. Two *malformations* of the ureters have been found as causes of hydronephrosis : 1, a kind of congenital valve in the very commencement of the ureter ; and, 2, an origin of the ureter from the upper instead of the lower end of the pelvis, so that the pelvis fills before it is emptied, and in the full condition may press upon the valve-like opening of the ureter and close it.

As *abnormalities*, there may be but a single ureter, or as many as three.

PHYSIOLOGY.

The urine flows through the ureters partly by the action of gravity in the erect position, but more especially by means of the peristaltic contraction of the muscular layer in its walls. These contractions occur somewhat irregularly. Thus, I have seen, through the cystoscope, the end of a contraction as shown by the opening of the slit-like orifice into the bladder as follows : After the first contraction there was another in four to five seconds, and then, after an interval of sixteen to twenty seconds, two more at intervals of four to five seconds, etc. Others have described the contraction as occurring once every three quarters of a minute or so. Reflux is prevented by the oblique passage of the ureters through the bladder wall.

III. THE URINARY BLADDER.

The bladder serves as a reservoir for the urine, and has an average *capacity* of about a pint, or 400 to 500 c. c., but may hold as much as 1,000 c. c. under normal conditions.

In cases of distention due to retention, the bladder has contained as much as 3,000 to 4,000 c. c. of urine, while some contracted bladders have a capacity of no more than 10 to 20 c. c. The bladder of the male is somewhat more capacious than that of the female. The different parts of the bladder are designated from their position ; thus, the summit

or apex refers to the upper and more narrow end; the fundus or base to the broader lower end, resting on the perinæum in the male, the vagina in the female.

The term fundus has been limited to that part of the lower half between the orifice and the fold of peritonæum, and not covered by peritonæum. There is no anatomical neck.

Further, we distinguish an anterior surface which looks also downward, a superior surface looking also somewhat backward, an inferior surface or base looking also backward, and two lateral surfaces.

The **size**, **shape**, and **position** of the bladder vary with its degree of distention. The shape of the empty bladder is much disputed, but either

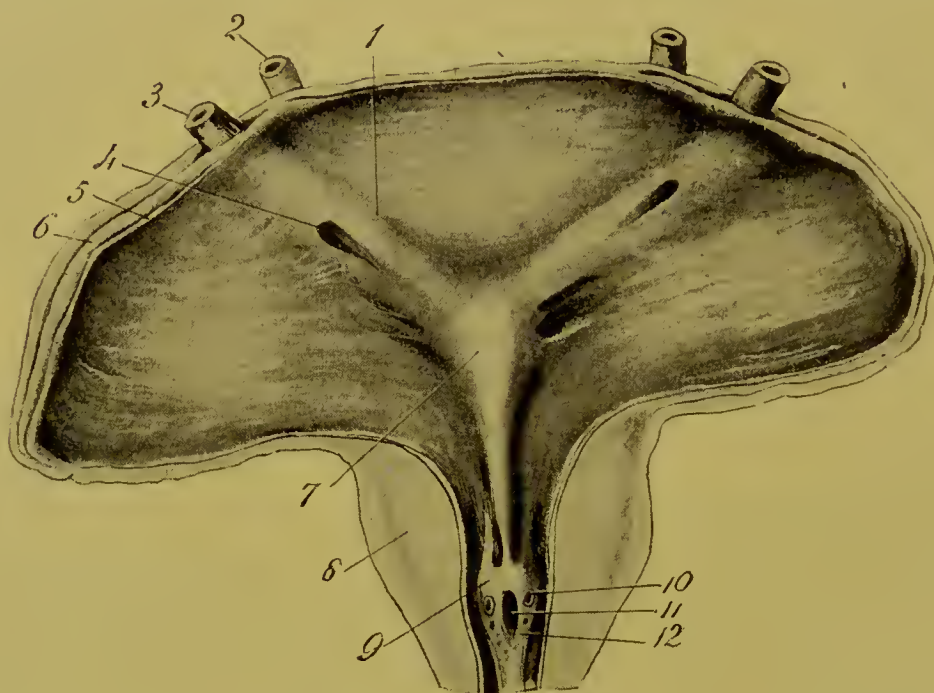


FIG 7.—Lower part of the male bladder, with the beginning of the urethra. Exposed by incising the anterior wall and laying it open. 3, ureter; 4, opening of the ureter; 2, vas deferens; 9, colliculus seminalis; 7, Bell's muscle; 8, section of prostate; 10, orifice of the common ejaculatory duct; 11, opening of utericle; 12, mouths of prostatic gland-ducts; 1, Mereier's band. (Henle.)

of two forms may occur: first, oval, like a small lemon, firm, flattened anteriorly, convex superiorly toward the abdomen, and the bladder cavity with the urethra forms a curved slit on sagittal section; second, this is larger and softer, triangular on section, the superior wall is concave toward the abdomen, and fits into the concavity of the inferior wall. On sagittal section the bladder with the urethra forms a Y-shaped figure, the angle of the Y corresponding to the concavity named. This has been called a diastolic empty bladder, in distinction to the former or systolic one. When moderately distended it has various forms, according to the condition of the surrounding viscera—rounded, flattened, or transversely

oval—but it still lies within the pelvic cavity. If completely distended it is oval, and its summit lies above the pelvis and against the anterior abdominal wall. The anterior wall is flattened, resting against the symphysis, while the convexity of the posterior wall is increased so that it may lie higher than the apex, which has curved more and more forward. When fully distended the bladder is often flattened from above down-

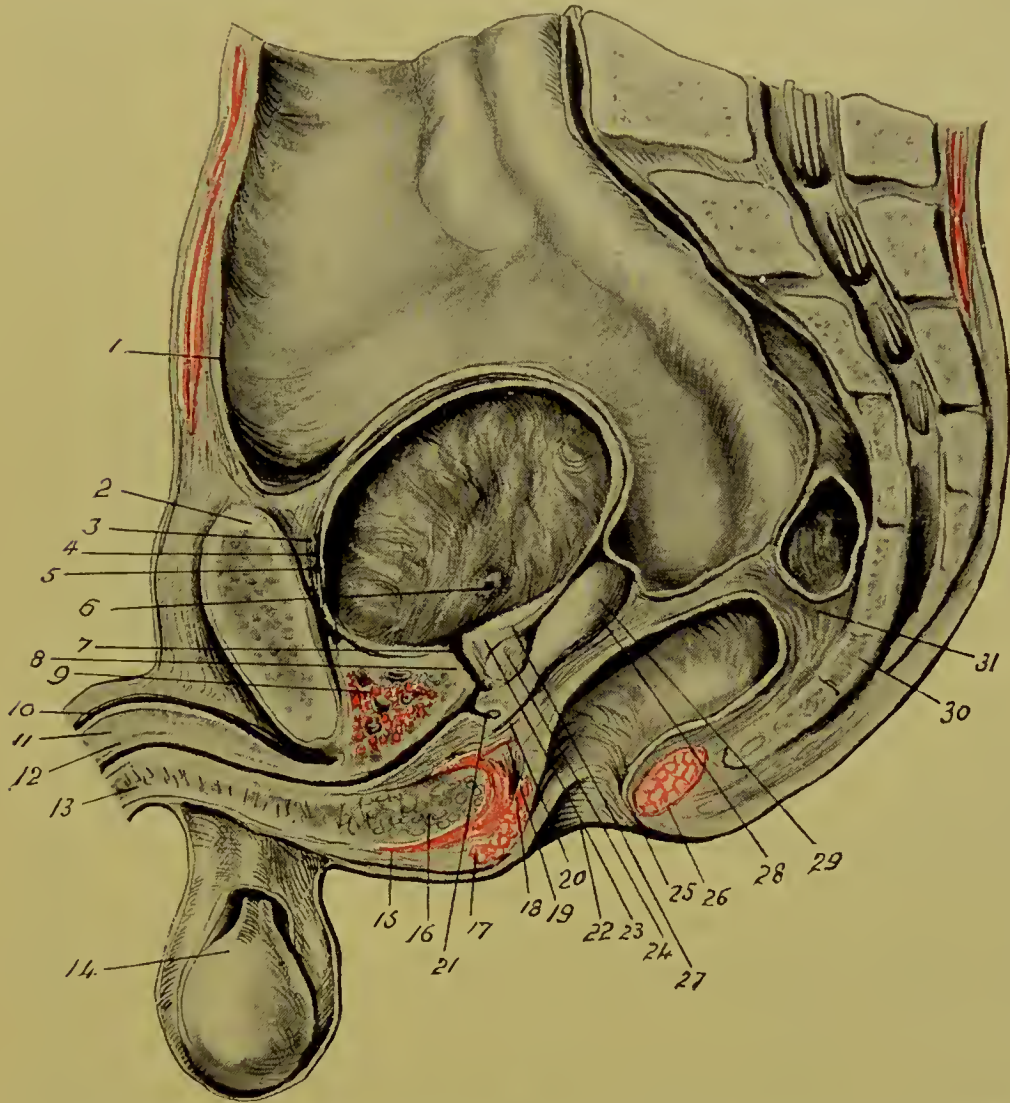


FIG. 8.—Median section of a frozen male subject. The small intestine is removed. 1, peritonæum; 6, opening of the ureters; 8, internal sphincter vesicæ; 9, external sphincter, with the compressor urethræ muscle; 10, dorsal vein of the penis; 15, bulbo-cavernosus muscle; 16, bulb of the urethra; 17, sphincter ani; 21, utricle; 24, "middle portion" of prostate; 29, seminal vesicles. (Henne.)

ward, and bulged laterally. The base depresses the perinæum. When completely distended the bladder does not lie in the median line, but deviates slightly to the right, due partly to the rectum on the left side, and partly to the greater size of the right half of the bladder.

The distended bladder may even reach as high as the diaphragm.

Position.—In the erect position the orifice of the bladder is the most dependent part, and lies in a horizontal line drawn through a point a little below the middle of the symphysis pubis, and it lies one and a quarter inch behind the latter. The long axis of the distended bladder is directed nearly horizontally from the coccyx to the upper margin of the symphysis. It is within the pelvic cavity, except when distended. It lies on the rectum or vagina below, against the anterior pelvic wall in front, and in contact with the rectum, small intestines, and uterus behind.

Relations.—The base of the bladder rests on the front of the second part of the rectum, separated from it and at the same time connected with it by the recto-vesical fascia. That part of the bladder firmly connected with the rectum corresponds to the trigonum on the internal surface, and here the bladder may be punctured from the rectum, about one and a half inch above the angle in the anterior wall of the latter. Above the base of the trigonum the bladder and rectum are separated by the recto-vesical fold of the peritonæum. In the female the bladder and rectum are separated by the vagina and cervix uteri, the two latter having the same relation to the bladder as does the rectum in the male. Lying between the rectum and bladder in the male, bounding the sides of the triangular space where the two are firmly bound together, and converging toward the orifice of the bladder, are the seminal vesicles, with the vasa deferentia internal to them. These are held to the inferior surface of the bladder by the process of recto-vesical fascia separating bladder and rectum. Behind the base of the attached area of the bladder the vasa deferentia curve upward, and then forward and outward, on to the lateral surfaces of the bladder, passing between the bladder wall and the lower ends of the ureters, which enter the bladder just behind the posterior angles of this attached area. The base of the bladder further rests on the anterior part of the pelvic floor, or levator ani muscle, forming the upper or abdominal end of the “perineal body.” This is depressed in the distention of the bladder, and is therefore held up by the rectal bag in suprapubic operations.

The antero-inferior or pubic surface is separated from the symphysis and body of the pubes, the pelvic fascia, and, during distention, from the anterior abdominal wall, by loose areolar tissue, at the bottom of which, near the bladder, is often found a network of veins.

Relation to Peritonæum.—The peritonæum covers the whole of the superior surface from the apex down. It covers the lateral surfaces as low as the line of the obliterated hypogastric arteries, thus covering a part of the vas deferens lying on this surface. It is prolonged on to the base of the bladder as far as the upper end of the seminal vesicles in the male, and the base of the trigonum in both sexes; thence it passes on to the rectum in the male and the uterus in the female, forming the recto-

vesical and utero-vesical pouches, respectively. This pouch separates the bladder from the rectum in the male and the uterus in the female, and is usually filled with convolutions of the smaller intestine. The lower end of this pouch in the male is about one inch from the base of the prostate or three inches from the anus; in the female the fundus is free of peritonæum higher up, so that the utero-vesical pouch is not so deep as the recto-vesical. Normally the peritonæum lines the anterior abdominal wall down as far as the upper end of the symphysis pubis, from which it passes onto the summit and superior surface of the bladder. In

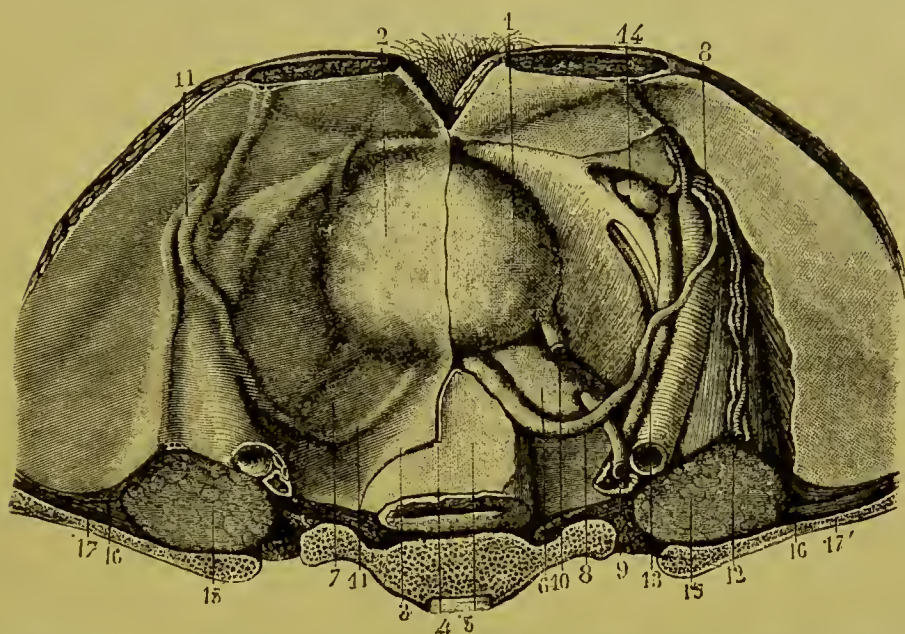


FIG. 9.—Relations of the posterior and inferior regions of the bladder in man. 1, right half of posterior surface of bladder; 2, left half covered with peritonæum; 3, semicircular fold which this membrane forms when empty; 4, median section of this fold; 6, right seminal vesicle; 8, seminal duct; 9, ureter; 11, 11', left ureter, covered by peritonæum; 12, spermatic vein and artery; 13, external iliac artery and vein. (Sappey.)

distention of the bladder, as its apex rises above the symphysis, in apposition with the anterior abdominal wall, the peritonæum is raised from the symphysis and forms a *cul-de-sac* between the upper end of the antero-inferior bladder wall and the wall of the abdomen. As the bladder rises into the abdomen the lower half of the distance between the apex of the bladder and the symphysis pubis is free of peritonæum. Thus, if the apex be half-way between the pubes and the umbilicus, the lower limit of the peritonæum is at least two inches above the symphysis. It is through this space, between the symphysis pubis and the lower end of the peritoneal *cul-de-sac*, that puncture or suprapubic incision of the bladder is performed, without wounding the peritonæum. The bladder wall proper is here separated from the abdominal wall by loose areolar tissue throughout a triangular space, with the base downward (*cavum Retzii*).

In this areolar tissue, inflammation, suppuration, or extravasation readily spreads. In some cases the peritonæum is found firmly attached to the symphysis pubis at its upper border, or even lower, and when this is the case it would be incised by a suprapubic incision, unless first dissected off and raised.

The female bladder, as compared with that of the male, is less capacious. Its neck lies a little nearer the symphysis, on a line with the lower border of the symphysis, and is very distensible, as there is no prostate. It is nearly as broad as it is long, and the peritonæum does not come down as far on to the base, which is of less extent.

The opening of the ureters is only three centimetres from the cervix uteri.

The bladder in the child lies largely above the pelvis in the abdominal cavity, and yet its anterior surface is uncovered by peritonæum, so that it is easily accessible in front. It is pyriform or egg-shaped, the vertical axis being greater than in the adult, and it has but little fundus. At birth the urethral orifice lies on a level with the upper end of the symphysis, and the peritonæum reaches the urethral orifice postero-inferiorly, the prostate being minute. The bladder wall is exceedingly thin.

Connections or Fastenings of the Bladder.—The bladder, though fairly firmly fixed, is found in inguinal, femoral, and vaginal herniæ. Above it is freely movable, but it is held in place below by ligaments of two kinds, true and false, and by its connections to neighboring parts. Thus it is fixed to the walls of the pelvis by the prostate, it is strongly joined by connective tissue to the rectum or vagina, and is less strongly held by the ureters, urachus, obliterated hypogastric arteries, and by numerous blood-vessels.

The *false ligaments* are folds of peritonæum as it is reflected from the bladder on to neighboring parts. Five folds or ligaments are found. One is median from the summit of the bladder to the umbilicus, triangular in outline, the sides of the triangle representing the obliterated hypogastric arteries. The course of the urachus, contained in this fold, bisects the triangle in passing to its apex. Posteriorly on either side a fold passes from the sides of the rectum, or uterus, and pelvic wall to the sides of the back of the bladder, known as the *posterior false ligaments*, in the bases of which lie the ureters. Between the two posterior false ligaments lies the recto or utero-vesical *cul-de-sac*.

The *lateral false ligaments* pass from the lateral pelvic wall to the sides of the bladder, but are not distinctly marked off from the posterior ligaments except by the line of the obliterated hypogastric artery. Under the fold of the lateral false ligaments pass the vas deferens and the vesical artery.

The *true ligaments* consist of reflections of pelvic fascia. The reflec-

tion on either side, passing to the side of the base of the bladder, is known as the lateral true ligament. The anterior true ligament, also known as the pubo-prostatic, passes from the back of the pubes at the level of the lower border of the symphysis pubis to the front and sides of the bladder just above the prostate, which the ligament embraces. Between these two

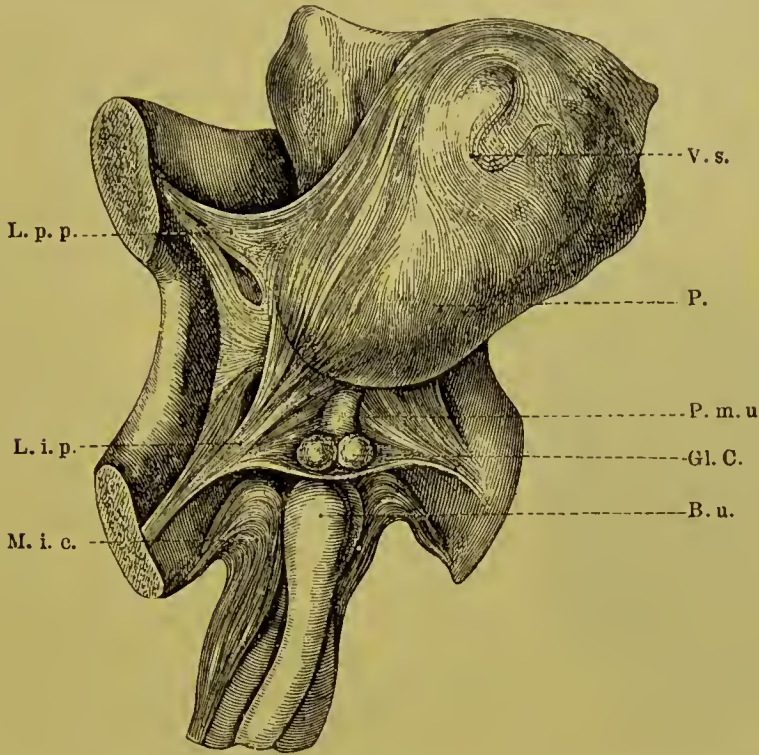


FIG. 10.—L. p. p., pubo-prostatic ligament; L. i. p., ischio-prostatic ligament; M. i. c., ischio-cavernosus muscle; V. s., seminal vesicles; P., prostate; P. m. u., membranous urethra; Gl. C., Cowper's glands; B. u., bulb of the urethra. (Dittel.)

anterior ligaments is a depression filled with loose connective tissue and fat, at the bottom of which lies a plexus of veins, in front of the prostate, connected with the dorsal vein of the penis.

The urachus itself might be considered a true ligament, as it consists of fibrous tissue with muscle-fibers prolonged from the bladder on to its lower part.

The foetal tubular condition of the urachus may persist, usually in the form of an interrupted cavity lined by an epithelium like that of the bladder. This may open at the umbilicus, and discharge a mucous secretion, or, in rare cases, urine may pass through the whole length and escape at the umbilicus.

Interior of the Bladder.—On opening the bladder, we find its interior lined by a smooth mucous membrane loosely connected with the other coats and thus thrown into rugæ when the viscus is empty. Furthermore, in some cases a network of muscular bands projects slightly into the blad-

der, the mucous membrane dipping down into the meshes of the network and forming the *sacculated bladder*. Corresponding to these saecules the bladder wall is thin, so that it may give way, forming one or more larger sacculi, in which important pathological changes may occur. At the base of the bladder there is a triangular area, the *trigonum*, where the mucous membrane shows no rugæ, as it is closely adherent to the parts beneath. This triangular area corresponds to that part of the base which is firmly adherent to the anterior rectal wall, and which is bounded on the sides externally by the *vesiculæ seminales*. The trigonum is very small in young subjects. Internally the three *openings* into the bladder are found at the angles of this trigonum. At the apex in front is the orifice

into the urethra, and at the angles of the base we have the oblique slits of the openings of the ureters, about one and a quarter to one and a half inch apart, and the same distance from the orifice.

Joining the openings of the ureters is a transverse curved ridge, and passing from the opening of both ureters is another slight ridge, which ends in a minute median projection, on the base of the bladder at the orifice, known as the *uvula vesicæ*, often giving the orifice a semicircular shape on cross-section.



FIG. 11.—1, 2, lateral oblique and straight fibers; 3, middle circular fibers.

The ridges mentioned above are due to the prolongation of the muscle-fibers of the wall of the ureters, and are known, the posterior as Mercier's bar, the anterior pair as Bell's muscle. Behind Mercier's bar there may be found a depressed pouch, especially in old age. The trigonum, more often in old age, may be elevated quite a little above the surrounding surface of the bladder.

Structure.—The partial covering of the peritonæum has already been sufficiently described. The outer of the three remaining coats is the *muscular*, composed of unstriated muscular fibers arranged in three layers more or less well marked. The *outer* or *longitudinal* layer is found especially on the superior and antero-inferior surfaces, passing from the "neck" up toward the summit, where some fibers are continued into the urachus, while at the lower end they are continued into the prostate or vagina, and, through the anterior true ligaments, to the anterior pelvic wall (musculi pubovesicales). Laterally these fibers are more or less oblique. The anterior wall is the thickest, owing to the thickness of its muscular coat, and is especially prone to hypertrophy. In the next deeper layer the fibers are more or less circular, especially in the lower part, where

they are somewhat aggregated, so as to be formerly called the *sphincter vesicæ*. They do not act as a sphincter, however, but merely to expel the last drops of urine, as shown by Henle and others. The most internal fibers form an incomplete layer of obliquely arranged reticulating fibers, which give the reticulated appearance to the interior of the bladder, especially when they are hypertrophied.

Internal to the muscular coat is a well-marked layer of areolar tissue, mixed with elastic fibers. This coat binds the muscular and mucous coats loosely together, more intimately connected with the latter, and allowing it to move freely on the former and to be thrown into rugæ when the bladder is empty. In the trigonum the muscular and mucous coats are closely bound together.

The mucous membrane lining the bladder is smooth, pinkish, and lax, to accommodate itself to the varying size of the bladder. It is lined by stratified epithelium of about three layers of cells, whose form varies with the fullness of the bladder, being flattened when the bladder is full, more or less cubical and oval when it is empty, and forming but a single layer when it is largely distended. Over the trigonum the mucous membrane does not stretch, so that the epithelium here does not vary in form. In the neighborhood of the orifice and fundus numerous very small racemose mucous glands may be found, and in some bladders one finds closely gathered, small, blunt papillæ, as well as in the lower end of the ureters, which probably stand in relation to the later appearance of papilloma.

Blood-vessels.—The *arteries* are the superior and inferior vesical from the internal iliac, the former through the pervious part of the hypogastrie. The uterine arteries in the female also send branches to the bladder. The base—which includes the trigonum—and the “neck” are the most vascular portions. The *veins*, forming a plexus around the base and neck of the bladder, where they communicate with the prostatic plexus, empty finally into the internal iliac veins. The venous plexus may form varicosities, which project into the interior of the bladder at its lower part.

Nerves.—The nerves come partly from the hypogastric plexus of the sympathetic and partly from the third and fourth sacral nerves, branches of the cerebro-spinal system. The mucous membrane of the trigonum and that lining the neck and lower part of the fundus of the bladder are very sensitive, being well supplied with sensory nerves, which are scanty elsewhere. The sensitiveness of the above-named parts is well seen when diseased.

Development.—The bladder, as well as the prostatic and membranous portions of the urethra in the male and the entire urethra in the female, is developed from the lower part of the intra-abdominal portion of the allantoic vesicle, the upper part of the same forming the uræthus. In

early foetal development the bladder vesicle connects with the cloaca through that part which afterward forms the trigonum, and this opening may persist between bladder and rectum in cases of mal-development.

IV. THE PROSTATE GLAND.

Although its very existence has been questioned, and clearly defined marks are wanting to indicate with precision its anatomical boundaries in all directions, yet it is enough of an entity, anatomically and pathologically, to deserve a description as such. It is a firm, partly glandular, partly muscular body, containing the upper portion of the urethra and adjoining the "neck" of the bladder. The shape is that of a short, truncated cone, compressed in front and behind, or like that of a chestnut, the base projecting farther upward behind than in front. The surfaces are anterior and posterior, and both are convex and flattened, the anterior surface looking also somewhat upward and the posterior downward. The

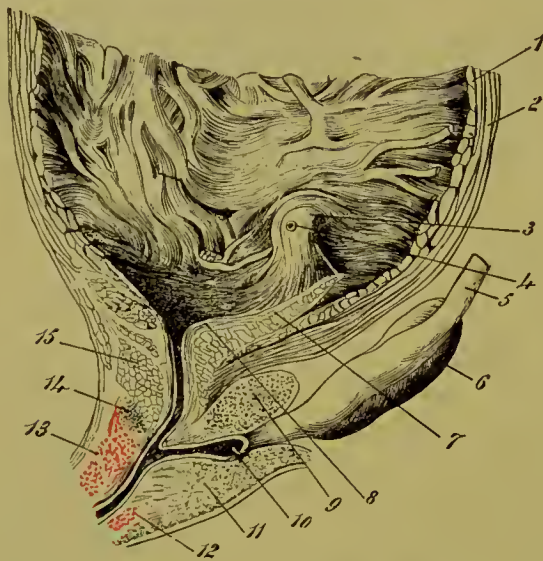


FIG. 12.—Median section of the lower part of the bladder, with the prostate, and beginning of the urethra. 1, inner; 2, outer layer of muscle-fibers; 3, muscle-fibers of ureter; 4, opening of ureters; 7, 12, sphincter vesicæ internus and sphincter prostatae externus; 10, utricule; 5, vas deferens; 6, vesiculæ seminales.

anterior or pubic surface is described as having a median longitudinal furrow corresponding to the course of the urethra; but this is not usually present here, though it does exist on the posterior or rectal surface as a shallow groove. Further, the course of the ejaculatory ducts is often indicated at the upper part of this surface by two slight lines. The base, looking upward and slightly backward, shows a funnel-shaped depression for the neck of the bladder, at the bottom of which is the urethral orifice, one quarter to one third nearer the anterior than the posterior surface. One quarter to one third of an inch farther back is another

funnel-shaped depression, where the ejaculatory ducts penetrate the "middle portion." The apex is somewhat flattened as it rests on the inner layer of the deep perineal fascia. The lateral borders are prominent and rounded.

Size.—The transverse diameter is one fifth to one sixth greater than the antero-posterior, averaging one and three quarters inch, while the diameter from base to apex measures one and a quarter to one and a

half inch, and the thickness is but three quarters of an inch. The greatest distance between the prostatic urethra and the capsule of the gland in an average normal prostate is seven eighths of an inch. This is the measurement in the oblique diameter, outward and backward, which is the direction of the incision in lateral lithotomy.

The average normal weight is between four and a half to four and three quarters drachms, though both the size and weight may be very much increased in hypertrophy of the prostate.

Position.—The prostate is situated between the “neck” of the bladder above and the upper layer of the triangular ligament below. It rests on the rectum behind, and in front it lies just behind and below the lower border of the symphysis pubis, half an inch intervening in the erect position.

Relations and Connections.—The prostate is quite firmly fixed in the pelvis to neighboring parts, though it yields somewhat to a full bladder or rectum. It is joined to the bladder by a direct continuity of the longitudinal and circular fibers of that viscus, but especially of the circular fibers.

The passage through it of the urethra also fixes it to the bladder above and the deep layer of the perineal fascia below. It rests on the anterior wall of the rectum at the lower part of its middle portion, just where it bends to end in the third or anal portion, and at this point, the bend in the anterior rectal wall, it is easily palpated by the finger in the rectum. It is connected with and separated from the rectum by its outer capsular covering of recto-vesical fascia. Above and behind the common ejaculatory ducts enter the posterior part of the base of the prostate.

The sides of the prostate are embraced by the anterior true ligaments of the bladder, or pubo-prostatic ligaments, as they pass back from the pubes to the sides and front of the “neck” of the bladder. They leave between them a cellular interval, at the bottom of which lie the apex of the prostate and a part of the prostatic plexus of veins. Farther below and behind the most anterior part of the levator ani, known as the levatores prostatae, passes downward and backward, the most anterior fibers, proceeding beneath the apex to the central tendinous point of the perinaeum. The more posterior fibers are attached along the lateral borders of the prostate. The outer capsule of the prostate by its connections also serves to hold the gland in position. In CHILDREN the prostate is quite minute, and is more vertical, rounded, and softer than in adults, and it does not increase much in size until after puberty.

Structure.—The prostate has a double sheath or *capsule*. The external is firm and fibrous, and consists of a reflection of recto-vesical fascia, which is continuous with the deep layer of the deep perineal fascia at the apex of the gland. The inner or proper capsule, though thin, is firm, and

is not continuous with any other fascia, but is composed of muscular, connective, and elastic-tissue fibers continuous with that in the stroma of the gland. It can not be readily removed from the gland. Between these two coverings is situated the prostatic plexus of veins, continuous with the dorsal vein of the penis, and especially developed at the sides of the prostate.

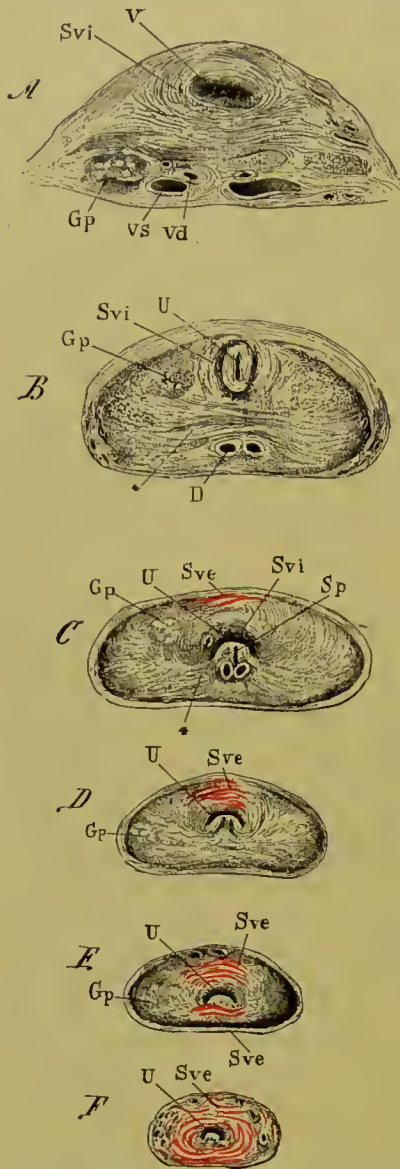


FIG. 13.—Cross-sections of the prostate in a series from base to apex. V., urethral orifice of bladder; U., urethra; V. d., vas deferens; V. s., vesiculæ seminales; D., common ejaculatory duct; S. p., utricle; S. v. i. and S. v. e., sphencter vesicæ internus and sphencter prostatae externus; *, muscular septa.

Lobes.—The prostate is usually described as composed of three lobes. Up to the fifth month of foetal life the prostate consists of two laterally placed lobes. These two lobes are joined in the median line along their anterior edges by the so-called *anterior commissure*, which is narrow, and contains no glandular tissue.

Posteriorly the two lobes are similarly joined below by the posterior commissure, but above the two lobes diverge behind, leaving a pyramidal-shaped space behind the upper end of the urethra and “neck” of the bladder, which is filled by tissue rich in glands. This tissue represents the so-called third or middle lobe, and, though it is subject to pathological changes by itself, its anatomical features do not justify the term lobe, but it is better to call it the “*middle portion*,” as do the French.

This rounded pyramidal “middle portion” is penetrated by the two common ejaculatory ducts. It lies behind the verumontanum, and it is prone to hypertrophy.

When the so-called *middle lobe* is present it is a morbid growth, causing obstruction to micturition, and is seen projecting between the openings of the urethra and ejaculatory ducts.

The *course of the urethra* through the prostate is from the base a little anterior to its middle, to the apex. In its course from base to apex,

the distance of the urethra from the anterior and posterior surfaces is about equal, though it is generally described as lying nearer the posterior surface, and it sometimes does so to a slight extent. Very rarely the urethra grooves the surface of the prostate instead of tunneling through it.

The *course of the common ejaculatory ducts* is downward and forward for the distance of half an inch. They enter the base of the prostate in the "middle portion" in a funnel-shaped depression one quarter to one third of an inch posterior to the urethral opening; they then pass side by side, separated by a thin stratum of tissue, until they reach the prostatic utricle in the walls of which they lie, and open one on either side of the opening of the utricle in the floor of the prostatic urethra.

The Muscular Tissue of the Prostate.—Just external to the mucous membrane is a thin layer of longitudinal pale muscle-fibers, continuous above with the fibers of the innermost layer of the bladder, and continued more or less throughout the entire urethra.

External to these fibers is a thicker but unevenly distributed layer of circular fibers continuous above with the circular fibers of the bladder, and continued below as far as the bulbous portion of the urethra. These circular fibers, surrounding the urethra, are grouped together at the base of the prostate and here form the *internal sphincter* of the bladder or prostate. In the middle of the prostate they form a thinner layer, but are again somewhat aggregated toward the apex of the gland, where they are mingled with striped muscle-fibers to form what is sometimes called



FIG. 14.—A healthy prostate from a man aged thirty-five years, with its posterior or rectal surface downward—the internal meatus being seen above, and the ejaculatory ducts in their depression below. (Thompson.)

the *external sphincter* of the prostate. The striped muscle-fibers of this "sphincter" are first found as we pass from above downward, only in front of the urethra, lying transversely; then in a crescent in front, and still lower down, they encircle the urethra. Both the circular and longitudinal fibers contain elastic and connective-tissue fibers. Throughout the rest of the prostate muscle-fibers occur abundantly, mixed with fibrous and elastic tissue to form the stroma of the gland, supporting the glandular elements and continuous with the muscle-fibers in the proper sheath of the gland. These fibers radiate more or less from the line of the urethra. The glandular portion of the prostate occurs most abundantly in the lateral lobes and in the portion behind the urethra, especially the "middle portion." The glands resemble, though not exactly, racenose

glands. They appear yellowish on section, and occur in "lobules," forty or fifty in number. Their ducts open on the floor of the prostatic urethra, especially in the sinus prostaticus, by twenty to twenty-four openings. Concretions are very commonly found in the prostatic glands.

Vessels and Nerves.—The prostate is supplied by branches of the inferior vesical, together with smaller branches from the internal pudic and middle hæmorrhoidal arteries. The accessory pudic artery, when present, passes along the anterior surface of the prostate, before perforating the deep layer of the triangular ligament, and gives branches to the gland. The prostatic *plexus of veins*, communicating with those at the base of the bladder, the hæmorrhoidal and the dorsal vein of the penis, empties into the internal iliac vein. Phleboliths occur frequently in these veins. The *lymphatics* accompany the veins.

The *nerves* are derived from the prostatic plexus, a continuation downward of the hypogastric plexus, and comprise both medullated and non-medullated fibers. The nerves to the penis send filament to the prostate in passing.

V. THE PENIS.

The *penis* is composed of three cylindrical masses of erectile tissue, the two corpora cavernosa and the corpus spongiosum, joined together by fibrous tissue into a three-sided body, which is covered with skin and contains the spongy portion of the urethra. It is attached at its *root* to the symphysis pubis, pubic arch, and triangular ligament of the perinæum



FIG. 15.—Diagram of urethra in natural condition. *a, b, c*, representing the prostatic membranous and spongy portions respectively. (Thompson.)

by means of the suspensory ligament, the erura of the corpora cavernosa, and the bulb of the corpus spongiosum, respectively. In front it ends in a more or less conical expansion, the *glans penis*, continuous with the corpus spongiosum.

The *body* of the penis has three sides and three rounded borders. The *glans* is conical, flattened from above downward, and has a longer dorsal than ventral surface. It has, a little below the center of its rounded extremity, a vertical slit, the meatus or external orifice of the urethra, from the lower end of which passes a narrow fibrous cord, the frænum præputii, to be attached at its other end to the prepuce. The base of the glans is expanded, and projects above the level of the body of the penis. This is known as the *corona*, and is obliquely placed, extending farther toward

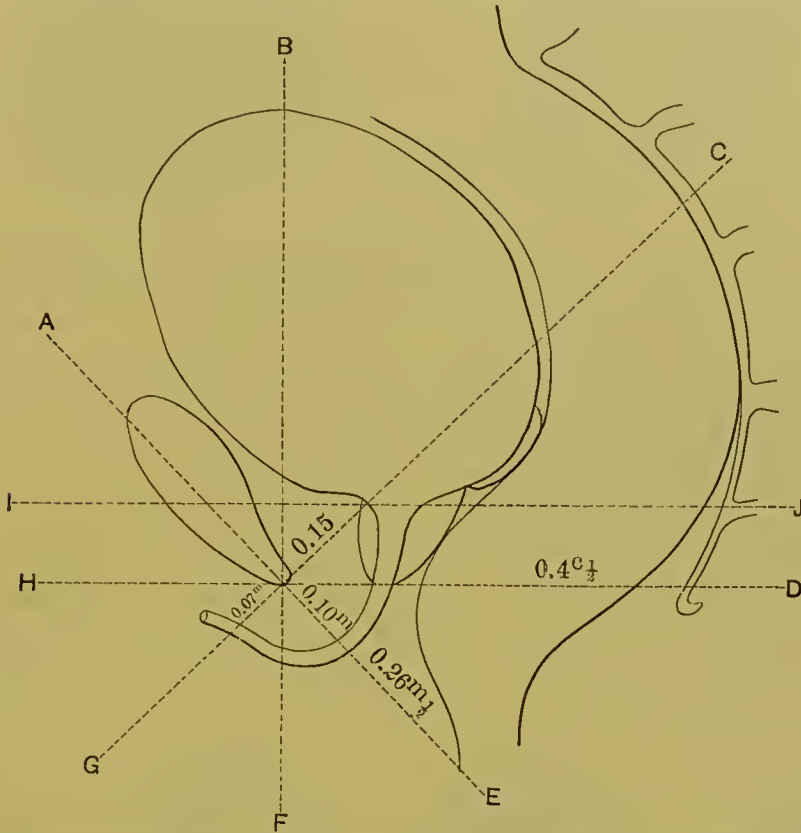


FIG. 16.—Scheme designed to show the direction of the urethra, and its relation with the symphysis pubis. (Sappey.)

the root of the penis above than below, where it is interrupted in the middle line by the frænum. Behind the corona is the constriction called the *cervix*.

Structure.—The corpora cavernosa are attached one to each side of the pubic arch, where they are expanded and then taper off, as we trace them backward on to the ischium, and are known here as the *crura*. The crura are invested by the ischio-cavernosi or erectores penis muscles. They converge in front of the symphysis and come to lie side by side, blended together for their anterior three fourths and flattened on their median aspects. From their point of union forward they are closely bound together by a common bluish, elastic, shiny sheath, in which muscular

and elastic fibers are numerous. Each corpus cavernosum is further provided with a separate similar sheath of its own, forming a median partition between them. This median septum is not complete in the anterior part, where there occur numerous vertical slit-like openings where the two corpora cavernosa communicate with one another, giving the name

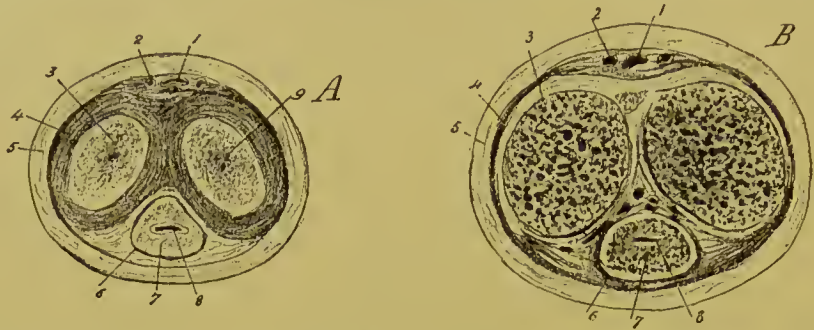


FIG. 17.—Cross-section of the penis. *A*, in flaccid, *B*, in erect condition; 1, dorsal vein of penis; 2, dorsal artery of penis; 3, network of the corpus cavernosus; 4, skin of the penis; 5, network of the corpus spongiosum; 6, urethra. (Henle.)

of *septum pectiniforme* to what remains of the septum. At the point where the two corpora cavernosa diverge from one another their fibrous sheath is reflected on to the inferior pubic angle to form a continuous structure with the anterior layer of the triangular ligament. The elasticity of the coverings of the corpora cavernosa readily allows of change in size, as in erection of the penis. The corpora cavernosa are composed entirely of erectile tissue, the trabeculae of which are continuous with their sheath, and are composed of the same fibrous, elastic, and muscular elements. The corpora cavernosa end anteriorly in a blunt conical ex-

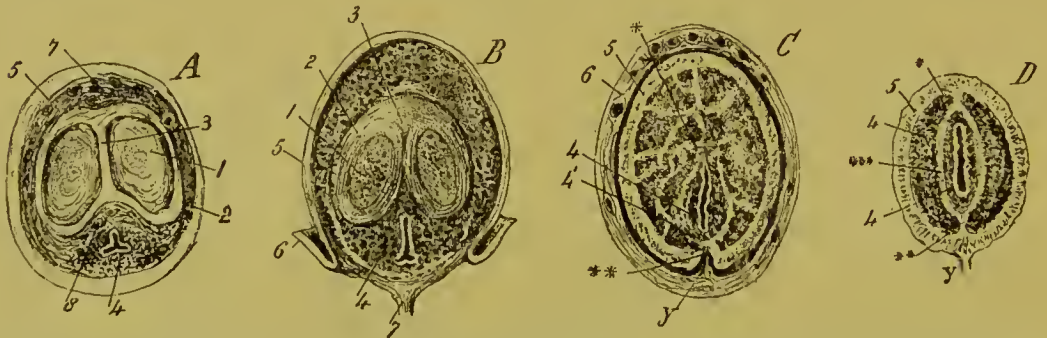


FIG. 18.—Cross-section through the cervix and glans penis. *A*, through the cervix; *B*, through the posterior border of the glans; *C*, through the middle of the same; *D*, just behind the meatus; 1, corpus cavernosum; 2, sheath of same; 3, septum between the same; 4, corpus spongiosum; 5, skin of glans; 6, prepuce; 7, dorsal veins; *, connective tissue connecting frenum with sheath of corpus spongiosum; *y*, frenum. (Henle.)

tremity, which is received into the base of the glans penis. In the groove on the upper surface between the two corpora cavernosa lies the dorsal vein of the penis, while the groove on their under surface lodges the corpus spongiosum.

The *corpus spongiosum* is a single median mass of erectile tissue lodged below and between the two corpora cavernosa and containing the spongy portion of the urethra. It begins posteriorly by a rounded expansion, the *bulb*, which is closely applied to the front of the triangular ligament, behind the point of union of the corpora cavernosa, and is situated mostly below the urethra. The bulb is closely invested by the bulbocavernosus or accelerator urinæ muscle. It presents, on its under surface, the indications of a division into two lateral halves, the indications consisting of a slight median furrow superficially, and internally an incomplete fibrous septum. The corpus spongiosum ends in an anterior expansion—the glans, already described. Throughout its course it is closely bound to the sheath of the corpora cavernosa, as its bulb is to the triangular ligament, which is continuous with that sheath. The urethra, passing through the upper part of the bulb, lies in the center of the body of the corpus spongiosum and in the lower part of the glans. Like the corpora cavernosa, it consists of erectile tissue, though its venous spaces are smaller and its fibrous sheath is thinner and more elastic. The elasticity of the corpus spongiosum is lost in chordee, so that it acts like the string of a bow in erection of the penis. The *fascia penis* is a compact fibrous and elastic layer, investing the structures already described, attached firmly around the cervix, continuous behind with the superficial perineal fascia and in front with the *suspensory ligament* of the penis. This ligament or thick band of fibro-elastic tissue, triangular in form, connects the anterior part of the symphysis pubis with the two corpora cavernosa at their angle of junction. Its anterior border is free.

Outside of the fascia penis is a loose layer of areolar tissue loosely connecting the skin and fascia, and allowing very free movement of the former. It is owing to the laxity of this tissue, which extends to the end of the prepuce, that very large oedematous or inflammatory swellings so rapidly occur in the penis. For the same reason also the skin of the penis can readily be drawn down over the organ—a fact to be remembered in circumcision, otherwise the entire skin of the penis may be removed. The skin is thin, very distensible and movable, free of fat and also of hairs in its anterior two thirds. Beneath, in the middle line, there is the indication of a median raphé continuous with that of the scrotum.

At the level of the cervix the skin is doubled into a loose fold of

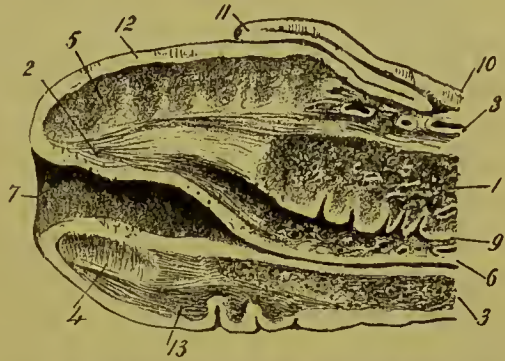


FIG. 19.—Median section of the glans penis, etc. 1, corpus cavernosum; 3, corpus spongiosum; 5, substance of glans; 7, fossa navicularis; 8, venous network of dorsum; 10, skin; 11, prepuce; 12, skin of glans; 13, frenum. (Henne.)

varying length, the prepuce, the internal layer of which is firmly attached around the cervix, and thence is continued over the glans. The skin on the inner surface of the prepuce, and that covering the glans, approaches the type of a mucous membrane, being red, moist, and thin.

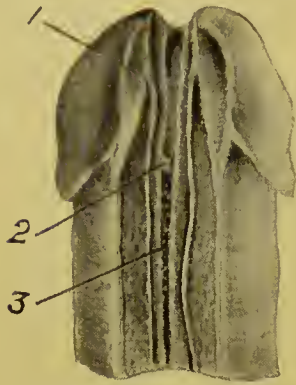


FIG. 20.—End of the penis from below, the urethra opened in the middle line below. 2, valvula fossæ navicularis; 3, lacunæ. (Henle.)

Around the cervix are gathered numerous sebaceous glands, called *glandulæ odoriferæ*, from the peculiar odor of their secretion; elsewhere in the anterior two thirds of the penis sebaceous glands are almost or entirely wanting. Over the glans there is no subcutaneous connective tissue, but the skin is intimately connected to the spongy tissue beneath. Thus, a chancre here has little if any induration, owing to lack of tissue to become infiltrated; while a typical indurated chancre may occur at the corona, where the subcutaneous or submucous tissue is abundant and lax. In the skin over the glans occur many large vascular and nervous papillæ. Beneath the skin of the penis, and connected with it, is a thin layer of muscular

fibers, continuous with the dartos of the scrotum. It forms a partial sphincter at the end of the prepuce.

Vessels and Nerves.—The arteries of the penis are numerous, and comprise the following branches of the internal pudic, the artery of the bulb, the artery of the corpus cavernosa, and the dorsal artery of the penis, as well as branches from the external pudic arteries. The *veins* accompany the arteries, and most of them communicate with the prostatic plexus. It is rather remarkable that the dorsal vein of the penis is single, while there are two arteries of that name. This vein lies beneath the fascia penis, as well as its arteries, and perforates the triangular ligament half an inch below the subpubic angle.

The *nerves* of the penis include the dorsal nerve of the penis, a branch of the pudic nerve, and branches of the prostatic plexus of the sympathetic, the latter distributed to the erectile bodies.

The *lymphatics* are numerous in the skin and subcutaneous tissues of the prepuce and glans, and pass chiefly into that set of inguinal glands situated most internally.

Development and Abnormalities.—The penis is developed from two lateral halves which fuse together along their median surfaces. The urethra is at one time but a groove on their under surface, the edges of which grow together inferiorly from the proximal to the distal extremity, to form the urethral canal.

Abnormalities occur from failure to unite along the upper or lower borders of the median surface, resulting in epispadias and hypospadias,

respectively, of which the latter is by far the more common. It occurs in all degrees, from a slight lengthening of the meatus below to a complete failure to unite along the entire spongy urethra. All degrees of approach to hermaphroditism are caused by the complete or partial failure of the bilaterally formed external genitals to unite mesially.

The end of the prepuce may be congenitally narrow, causing congenital phimosis. The opening may be as small as a pin-point or only slightly narrowed, just preventing its retraction. This condition hinders the development of the glans, and is apt to set up adhesions between the prepuce and glans; hence the advisability of early operation.

VI. THE URETHRA.

The male urethra extends from the urethral orifice of the bladder through the prostate, the two layers of the deep perineal fascia, and the length of the corpus spongiosum, to end at the meatus at the extremity of the glans penis. Corresponding to the parts through which it passes, it has been divided, for convenience of description, into three parts, which have received the following names in order from above downward—prostatic, membranous, and spongy or penile portions.

The urethra can not be regarded, strictly speaking, as a canal, but rather as a closed valve, the walls of which are usually in close apposition, and which is only open for a few seconds at a time to transmit fluids.

The *length* of the urethra averages eight and a half inches in the dead subject, and seven and a half to seven and three quarters inches in the living. The condition of the penis may alter the length temporarily, and a hypertrophied prostate may lengthen the urethra.

To give the *caliber* of the urethra in absolute figures is impracticable. Its relative dilatability is more important. This varies in the different parts of the urethra. The meatus is the narrowest and least dilatable part, averaging about a quarter of an inch in length, and admitting a 24 (French) sound. Next comes a spindle-shaped dilatation, the fossa navicularis, contained in the glans penis. The caliber again narrows, and continues uniform until we reach the bulb, where it is dilated, pouch-like, along the floor. This part is about the same in caliber as the prostatic portion, and even more dilatable. The membranous portion is, next to the meatus, the narrowest part of the urethra. Its caliber is uniform, and it is much more distensible than is the meatus. In the prostatic portion again we have a spindle-shaped dilatation, narrowing to the upper end, where we have the orifice of the bladder. This portion is also very dilatable.

We have therefore from end to end a narrow portion alternating with a dilated portion. Any instrument which can pass the meatus should also

pass the rest of a normal urethra. In the order of dilatability the different parts are arranged as follows : The meatus is least dilatable, next the mem-

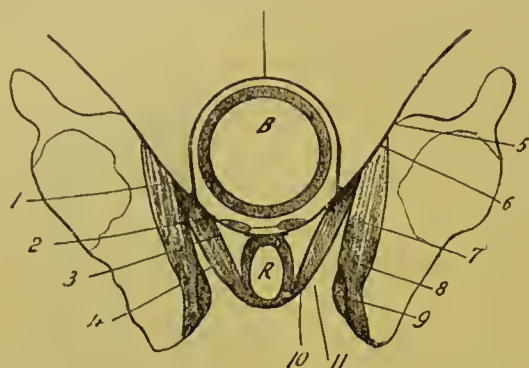


FIG. 21.—Diagram of oblique coronal section through the pelvis, showing the cut outline of the fascia. *B*, bladder; *R*, rectum; 1, white line; 2, recto-vesical fascia; 3, rectal fascia; 4, levator ani; 5, united iliac pelvic fascia; 6, pelvic fascia; 7, obturator internus; 8, obturator fascia; 9, Alcock's canal; 10, anal fascia; 11, ischio-rectal fascia. (McAllister.)

branous portion, the spongy portion, the prostatic portion, and, lastly, the most dilatable is the bulbous portion. The following figures indicate the relative rather than the absolute caliber of the canal, and are given both in fractions of an inch and in the number of the sound (French scale), which can pass without giving pain : Meatus, three tenths of an inch, 24 sound ; spongy portion, six tenths of an inch, 28–30 sound ; bulb, seven tenths of an inch, 32 sound ; membranous portion, five tenths of an inch, 26, 27 sound ; prostatic portion, seven tenths of an inch, 30–32 sound ; orifice of bladder, five to six tenths of an inch. According to Otis, there is a constant relation between the caliber of the urethra and the circumference of the penis.

The Direction of the Urethra.

—In the anterior three quarters or so of the spongy portion the parts inclosing the urethra are very movable, so that this part of the urethra can not be said to have any fixed direction, except that given it by gravity, hence the name (*pars pendula seu mobilis*). Posteriorly the corpora cavernosa become attached to the pubic rami, and the corpus spongiosum to the triangular ligament, hence the posterior two inches or so of the spongy portion, or that part lying behind the angle of junction of the corpora cavernosa, is more or less fixed (*pars immobilis*, etc.). Here the canal begins to curve

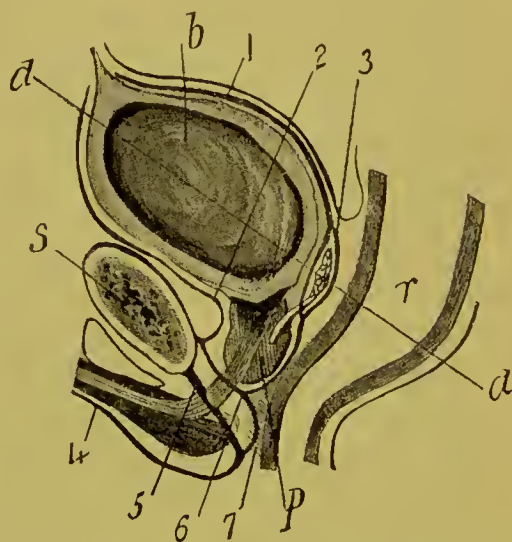


FIG. 22.—Sagittal section through bladder and rectum. *r*, rectum; *b*, bladder; *p*, prostate; 1, superior vesical fascia; 2, superior true ligament; 3, fascial sheath for vesiculæ seminales; 4, Colles'; 5, anterior layer; 6, suprapubic fascia; 7, perineal body. (McAllister.)

beneath the symphysis, and in the membranous portion ascends (in the erect position of the body), with a slight curve, convex upward and for-

ward, which is continued through the prostatic portion. The curve begins about one and a half inch anterior to the bulb, and forms the arc of a circle about three and a quarter inches in diameter, the chord of the arc averaging two and three quarters inches. In spare, small men the curve is sharper, and also in children, on account of the high position of the bladder in the latter. In large, stout men, on the other hand, the curve is flatter. The lowest portion of the curve of the urethra, in the erect position, is that in contact with the anterior layer of the triangular ligament, or the anterior part of the membranous portion and the posterior part of the bulbous portion. Various morbid conditions may interfere with the direction and curve of the urethra.

Prostatic Portion.—Its course through the prostate, averaging one and a quarter inch in length, has already been described. As above mentioned, it presents a large, spindle-shaped dilatation about its center, being narrower above and below. The upper boundary of this portion is the *uvula vesicæ*, passing from which we may trace on the floor of the urethra a slight ridge as a whitish band. Farther downward it rises into a narrow median ridge about one eighth of an inch high and eight to nine lines long, and then sinks down again, to be continued as a single or double white line along the floor of the urethra into the membranous and bulbous portions. This is variously called the *verumontanum*, *caput gallinaginis*, *crista urethræ* and *colliculus seminalis*. The longitudinal grooves on either side, called the *prostatic sinus*, are somewhat depressed, owing to the dilatation of the urethra at this point, and the floor is perforated by the orifices of the prostatic ducts. The prostatic sinus, even when not unusually deep, may impede the passage of a catheter. About the summit of the *verumontanum* is the opening of the *utricle*, in the lateral margins of which are placed the mouths of the two common ejaculatory ducts. The *utricle*, *uterus masculinus*, etc., corresponding to the uterine in the female, run backward and slightly upward in the "middle portion," and in the course of the ejaculatory ducts which lie on either side in its walls. It measures two and a half to four lines deep, and two to three lines in width. The *verumontanum* is composed in part of erectile tissue, and contains many of the longitudinal muscle-fibers of the wall of the urethra. On cross-section the shape of

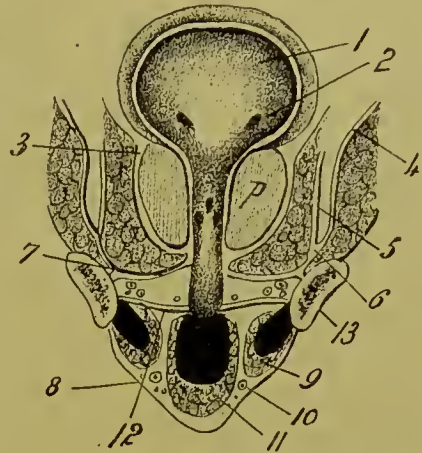


FIG. 23.—Diagram of slightly oblique coronal section of pelvis through the bladder, prostate, and urethra—the erectile bodies are darkly shaded. 1, bladder; 2, ureter; 3, capsule of prostate; 4, obturator fascia; 5, anal fascia; 6, forward continuation of these united; 7, deep layer of superficial perineal fascia of ischio-cavernosus; 8, long perineal artery; 9, bulbocavernosus; 10, long perineal artery; 11, bulbocavernosus. (McAllister.)

The longitudinal grooves on either side, called the *prostatic sinus*, are somewhat depressed, owing to the dilatation of the urethra at this point, and the floor is perforated by the orifices of the prostatic ducts. The prostatic sinus, even when not unusually deep, may impede the passage of a catheter. About the summit of the *verumontanum* is the opening of the *utricle*, in the lateral margins of which are placed the mouths of the two common ejaculatory ducts. The *utricle*, *uterus masculinus*, etc., corresponding to the uterine in the female, run backward and slightly upward in the "middle portion," and in the course of the ejaculatory ducts which lie on either side in its walls. It measures two and a half to four lines deep, and two to three lines in width. The *verumontanum* is composed in part of erectile tissue, and contains many of the longitudinal muscle-fibers of the wall of the urethra. On cross-section the shape of

the prostatic urethra is somewhat triangular, with its apex forward. The mucous membrane of this portion lies in delicate longitudinal plaits; it is of a pale, pinkish-yellow color, and is lined by cylindrical epithelium. With the longitudinal muscle-fibers just external to the mucous membrane is mingled more or less erectile tissue.

The **Membranous Portion**, or that part situated between the two layers of the triangular ligament, measures but one half to three quarters of an inch in length. This measurement is rather less along the floor of this portion where the bulb encroaches to some extent, though the projection of the latter on the triangular ligament is rather more away from the urethra than along it. It lies beneath the pubic arch, passing through the two layers of the triangular ligament about an inch below the sub-pubic angle. Its inferior convex surface is separated by a short interval from the third portion of the rectum, and looks toward the surface of the perinæum. Its mucous membrane, which is redder than that of the prostatic portion, is surrounded by an internal longitudinal and an external circular layer of muscle-fibers. The circular fibers are continued forward from the prostate, and with the longitudinal is mingled some erectile tissue continued back from the bulb. External to these layers the compressor urethræ, a voluntary muscle, surrounds the urethra, the fibers passing mostly transversely in front and behind the urethra. In the same compartment, between the two layers of the triangular ligament and supported on the anterior layer, lie the two *Cowper's* glands, one on either side and below the urethra. They are compound racemose glands, about the size of a pea, and of a yellowish color. Their excretory ducts run forward just beneath the urethra, to open on the floor of the bulbous portion by two small oblique openings. The ducts are one to one and a half inch long.

Spongy Portion.—This portion, six to six and a half inches in length, begins posteriorly in a dilatation—the *bulb*, or *sinus of the bulb*, as that part contained within the bulb is called. The dilatation occurs almost entirely on the floor and sides of the canal, so that the floor of this part may be one to three lines below the opening into the membranous portion through the triangular ligament. This and the membranous portion are on the lowest level of the curve of the urethra, in the erect position. The layer of fascia separating them forms the dividing line between the “anterior” and the “posterior” urethra. This distinction is an important one, on anatomical, embryological, pathological, and therapeutic grounds. The “posterior” urethra or muscular portion is active in micturition, less active in coition, while the “anterior” or erectile portion is passive in micturition, active in coition. The “posterior” is developed from the uro-genital sinus, the “anterior” from the surface.

At the anterior end of the spongy portion is another dilatation, the

fossa navicularis, occurring largely on the roof of the canal, and contained within the glans. The meatus is a firm vertical slit, while a cross-section of the spongy portion back of the glans shows a transverse slit.

The mucous membrane of this portion of the urethra has a cylindrical epithelium, except at the anterior extremity, where it approaches the squamous type and is deeper in color. External to the mucous membrane is a single layer of longitudinal muscle-fibers.

Throughout the *mucous membrane* of the urethra we find small racemose mucous glands and follicles, the *glands of Littré*. Besides these there are the larger *lacunæ*, whose openings, like those of the glands of Littré, point downward toward the meatus. There is one larger recess, the *lacuna magna*, situated on the upper surface of the fossa navicularis, one inch from the meatus and about one fifth of an inch deep. In this recess small bougies, etc., may readily be caught. The *valvula fossæ navicularis* is a fold of membrane often found about half an inch from the meatus on the inferior surface. This may be the site of an occasional congenital narrowing of the urethra.

PHYSIOLOGY OF THE BLADDER AND URETHRA.

Briefly stated, the physiology of the bladder consists in the study of its two functions of holding and voiding urine.

I. The urine is held in the bladder by means of the sphincters. There is no sphincter in the bladder itself, but they are placed along the upper portion of the urethra, one in the upper end of the prostate, superior or internal *sphincter vesicæ seu prostatæ*, one in the lower end of the prostate, inferior *sphincter prostatæ*, and one around the membranous urethra, the external sphincter or compressor urethræ muscle. The upper of these three sphincters is involuntary, the middle partly so, and the external wholly voluntary.

In old age the sphincters are weaker, so that old men can hold less urine, and must therefore urinate more often.

If the sphincters are paralyzed the urine dribbles, and spastic contraction may cause retention of urine.

II. Micturition consists of three factors: 1, the detrusors or the entire muscular coat of the bladder; 2, abdominal pressure aided by elevation and contraction of the diaphragm of the pelvis; 3, hydrostatic pressure. Besides these factors we must have a relaxation of the sphincters. As urine collects and distends the bladder, the internal pressure finally reaches such a point that the "internal sphincter" yields, and a few drops enter the prostatic urethra, causing a desire to micturate. This may be resisted for some time by the lower sphincters, by the action of the will, or they may be relaxed by the same action, when the expulsive forces mentioned empty the bladder. The last drops in the bladder are expelled by

the circular fibers near the orifice. The urethra is only open during the passage of urine, the last drops of which are expelled by the muscular tissue in its wall, aided by the accelerator urinæ, which helps to empty the bulb, and may hasten the flow of urine contained in it. Between the acts of micturition the sphincters remain closed, those composed of involuntary muscle-fibers continuously, those composed of voluntary muscle-tissue when irritated. Thus the passage of an instrument or the injection of a fluid into the anterior urethra receives such a check at the external sphincter or compressor urethræ muscle that a fluid can not pass, but flows back and is voided at the meatus. If the injecting catheter is passed behind this point, however, the action of the sphincters above does not prevent the passage of the fluid into the bladder.

VII. THE MALE PERINÆUM.

The *boundaries* of the perinæum proper are the rami of the pubes and ischium, and a line drawn between the two ischial tuberosities. These boundaries can be felt from the surface. The perinæum thus bounded has the form of an equilateral triangle, of which the sides measure three and a half inches. From the apex to the center of the base the measurement is one and a half to one and three quarters inch. The base is not a straight line between the ends of the side lines, but inclines forward in the middle toward the apex, corresponding to the course of the transversus perinei muscle. The depth of the perinæum, or distance from the skin to the pelvic floor, varies with the amount of subcutaneous fat, and averages two to three inches in the posterior part, while the anterior part is less than one inch in depth.

The *skin* of the perinæum is thin, quickly showing ecchymoses, and has in the median line a raphé continued forward on to the serotum and penis and backward to the anus.

Beneath the skin is the *superficial perineal fascia*, made up of two layers. The *external layer* contains the subcutaneous fat, and is continuous with similar tissue on either side and behind. The *deep layer* is firm and membranous. Behind, it passes around the posterior border of the transversus perinei muscle, where it joins the posterior end of the triangular ligament, and becomes continuous with the anal fascia lining the under surface of the levator ani muscle. At the sides it is firmly attached to the bony rami. In front it is continuous with the dartos of the serotum and the fascia of the penis.

On account of its connections there is but one outlet for fluids, etc., beneath it, and that is between the spines of the pubes on either side. The course of urine and other extravasations beneath it is therefore into the serotum and penis or on to the abdomen.

From this layer of fascia onward we have an aponeurotic layer alternating with a layer of muscles etc., so that the latter are inclosed on two sides by fascia, the other two sides being formed by the rami of the pubic arch. From the superficial perineal fascia there is an incomplete median septum partly dividing the space into two lateral halves. In the exact median line of the perinæum there is therefore but little danger of hæmorrhage, as even the bulb has a partial median septum, and apart from the

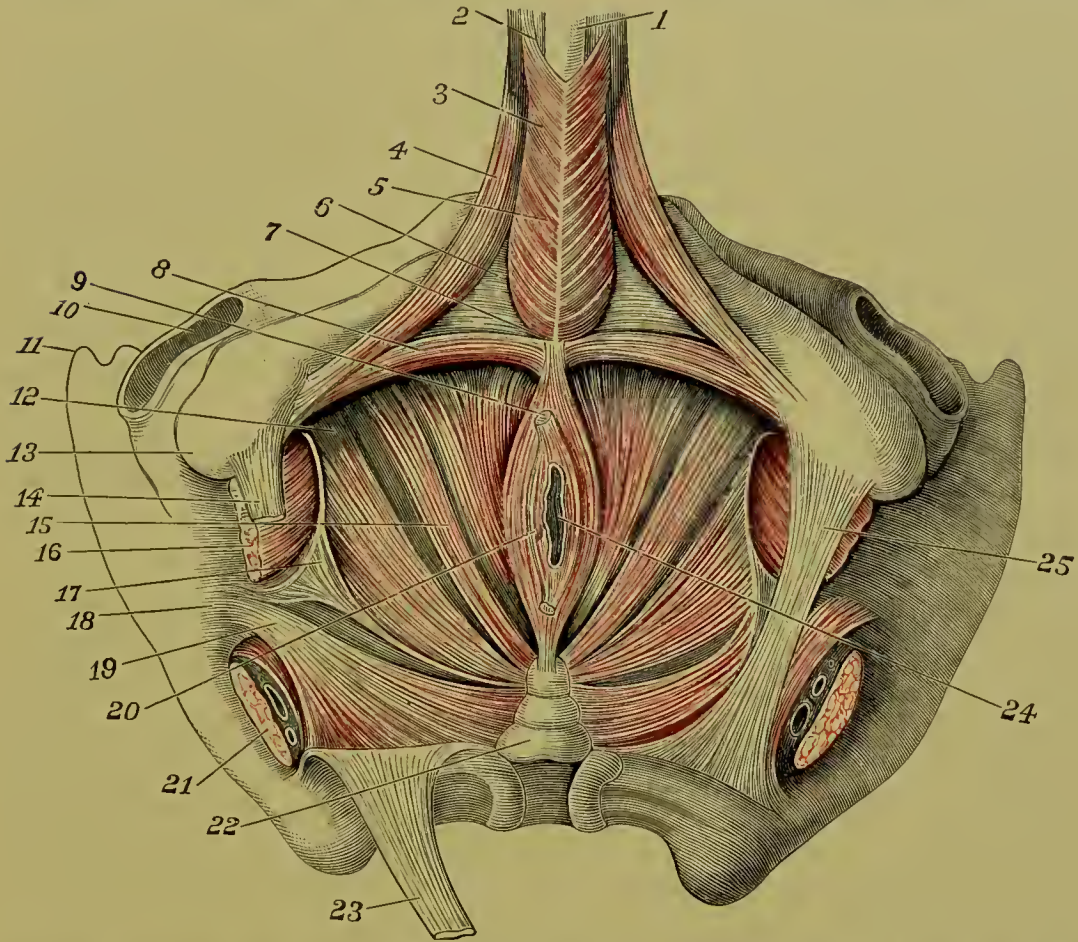


FIG. 24.—Dissection of perineal muscles. 13, tuber ischii; 14, great sacro-sciatic ligament; 18, spine of the ischium; 17, obturator fascia; 2, corpus cavernosum; 1, corpus spongiosum; 16, obturator internus muscle; 3, bulbo-cavernosus muscle; 4, ischi-cavernosus muscle; 8, transversus perinei muscle; 15, levator ani; 7, median; 5, transverse septum of the perineal muscles; 6, anterior layer of the deep perineal fascia. (Henle.)

bulb there is no danger of hæmorrhage here. The next layer consists of the bulb of the urethra and its spongy portion, as far as the serotum, three pairs of muscles, vessels, and nerves.

The bulb and corpus spongiosum are median in position.

The bulbo-cavernosus or accelerator urinæ muscle surrounds the bulb at its posterior end. Farther forward it passes around the sides of the bulb to become attached to the triangular ligament; still farther forward it passes around to meet in front of the corpus spongiosum; and the most

anterior fibers join the anterior fibers of the *erectores penis* muscles and pass in front of the *corpora cavernosa*, anterior to the dorsal vein of the penis. It is formed of two lateral halves united by a median fibrous raphé. The *erectores penis* muscles embrace the *crus penis* of either side. The superficial *transversus perinei* muscle passes forward as well as inward from the ischial tuberosities to join with the *bulbo-cavernosus* and *sphincter ani* muscles at the so-called central tendinous point of the perinæum, one inch or more in front of the center of the anus. The three muscles thus briefly described may form almost a continuous muscular layer (uro-genital diaphragm), or they may leave a considerable space between them in which is seen the next layer. With the *transversus perinei* muscles pass the branches of the internal pudic artery and nerve of the same name as the muscle; they are unimportant branches, however, and are divided by the incision in lateral lithotomy with impunity. The *deep perineal fascia* or *triangular ligament* consists of two layers, a superficial and a deep. They are attached respectively to the anterior and posterior margins of the internal borders of the pelvic rami as far back as the *tuber ischii*. Here the two layers are united, and are joined to the deep layer of the superficial fascia as it passes back behind the *transversus perinei* muscles to become continuous with the anal fascia. In front the two layers are separated, the greatest distance between the two varying from one half to three quarters of an inch. The anterior layer is continuous with the sheath of the *corpora cavernosa*, and to it the bulb of the *corpus spongiosum* is firmly adherent. The posterior layer is continuous with the pelvic fascia above the *levator ani* muscle intervening between the two below, and with it the sheath of the prostate is continuous. The depth of the triangular ligament from the subpubic angle to its base is one and a half to one and three quarters inch. One inch below the subpubic angle the triangular ligament is perforated by the urethra, that part of the urethra between the two layers being the membranous portion. The dorsal vein, arteries, and nerves of the penis perforate the anterior layer about half an inch below the angle of the pubes.

Between the two layers of the triangular ligament we have an osseo-aponeurotic compartment occupied by the membranous urethra, the compressor urethræ muscle, Cowper's glands, and the artery of the bulb. The compressor urethræ muscle has sometimes been described as consisting of two portions, a deep *transversus perinei* and a circular external sphincter muscle. This division is an artificial one; the fibers pass both more or less circularly around the urethra, and also transversely in front and behind or above and below the urethra. Laterally this muscle is attached to the borders of the pubic rami between the layers of the triangular ligament. It lies on a line more or less anterior to the superficial *transversus perinei* muscles. Its function is as a voluntary sphincter vesicæ, which may also

be excited by reflex action. The membranous urethra and Cowper's glands have already been described, the latter lying on either side of the median line, below the urethra, closely applied to the deep surface of the anterior layer of the triangular ligament.

The artery of the bulb passes inward, in this compartment, from the internal pudic artery to enter the bulb, after penetrating the anterior layer of the triangular ligament. In its course it lies about one and a half inch from the anterior margin of the anus, so that the incision in lateral lithotomy should not begin in front of this point, for fear of wounding this artery.

The posterior layer of the deep perineal fascia is continuous above with the pelvic fascia; lower down it has behind it another muscular layer, the anterior part of the levator ani muscle. On this layer rests the apex of the prostate, the sheath of which, formed by the recto-vesical fascia, is continuous with it. On the deep surface of the levator ani muscle lies the recto-vesical fascia separating the muscle from the sub-peritoneal connective tissue and the peritonæum.

Along the outer border of this space runs the main trunk of the deep perineal artery and nerve. At the tuber ischii the artery lies at a depth of one to one and a half inch from the surface of the tuberosity.

VIII. THE SCROTUM.

The *scrotum* invests the testes and lower part of the spermatic cord in the form of a double pouch. Its great mobility affords an admirable protection to the testes. A superficial division into two lateral halves by a median raphé indicates its embryological formation. The scrotum is made up of a number of layers, but practically there are but two layers, separated by loose connective tissue.

The *skin* is fine, thin, and transparent, thus showing an ecchymosis beneath it very quickly. It is elastic, allowing of great distention, as in large herniæ, etc., and also redundant, so that much may be removed without being missed. It is dark in color, and furnished with scattered, flattened hairs and sebaceous follicles whose secretion has a peculiar odor. It is thrown into *rugæ*, which are a sign of health. These *rugæ* are caused by the contraction of the next layer beneath.

The *dartos* is a reddish-brown, muscular layer continuous with the superficial fascia of the groin, perinæum, and penis, and differing from the latter by being entirely free from fat. The skin forms but a single pouch, a division into two parts being only indicated on the surface by the median raphé, which is continued forward on to the penis and backward on to the perinæum as far as the anus. The dartos, however, forms two separate pouches for the two testes. These two pouches are joined

together along the median line forming the so-called *septum scroti*, adherent to the raphé and extending to the root of the penis. The contraction of the dartos is slow and peristaltic, and it alters the shape and size of the scrotum. When the scrotum is incised, the contraction of the dartos is liable to invert the edges of the skin, with which it is firmly adherent. In fact, these two layers form but a single one, especially in the lower half of the scrotum. In the upper half of the scrotum the two layers may be somewhat separated by a subcutaneous connective tissue, continuous with that of the abdomen, in which the swelling due to œdema or elephantiasis may occur.

The layer formed by the skin and dartos is separated from and connected with the layer beneath by a cellular layer in which occur effusions of blood after contusion of the scrotum. This coupling layer is regarded by some as the INTERCOLUMNAR or SPERMATIC fascia derived from the tendon of the external oblique muscle of the abdomen at the external ring. Others speak of the spermatic fascia as firm, and closely connected with the next deeper layer.

The *cremaster* consists of scattered loops of striped muscle-fibers connected together by a fibrous membrane. Above, it is continuous with the lower border of the internal oblique muscle, or at least its attachments are similar to those of its conjoined tendon. This layer is known as the *cremasteric fascia*, and by its contraction the testicle is raised and the cord is shortened. The size of the cremaster varies with the weight it has to suspend. The cremasteric reflex is due to contraction of this muscle.

The *infundibuliform fascia* closely connects the cremasteric fascia external to it to the tunica vaginalis internal to it into a second or internal composite layer formed by the skin and dartos. This fascia is continuous above with the fascia transversalis, and is connected to the tunica vaginalis by a delicate areolar tissue continuous with the subperitoneal connective tissue. Astley Cooper named this the *fascia propria*. This layer closely invests the cord, and within it, among the loose areolar tissue in front of the cord, there can sometimes be traced from the internal ring to the upper end of the tunica vaginalis a fine fibrous cord. This is the remains of foetal *processus vaginalis peritonei*, which connected the peritoneal cavity with that of the tunica vaginalis. Below, the infundibuliform fascia is adherent to the back of the testis over a small area where the serous covering of the latter is wanting.

The *tunica vaginalis* forms a closed serous sac whose opposite walls are in contact. It is described in two parts, a *parietal* and a *visceral*. The *visceral layer* closely invests the testis except along its posterior border. Here it is reflected on to the epididymis lying along the outer side of this border. At the upper and lower ends of the epididymis the

serous membrane passes quite directly between it and the testis, but between these two points it forms a pouch (digital fossa) between the two. The fold which forms the pouch has been called the meso-testis. This layer invests the epididymis, except along its posterior border and over a small area at the two ends of its internal surface. The *parietal layer* closely invests the inner surface of the infundibuliform fascia, and forms a *cul-de-sac*, extending half an inch or so above the level of the testis and on either side of it at the beginning of the cord. At the lower end of the posterior superior border of the testis, where the visceral serous covering is reflected on to the parietal, the tunica albuginea of the testis comes in contact with and is adherent to the fibrous infundibuliform fascia. This anchors, as it were, the testis to the inferior and posterior part of the tunica vaginalis, and this is its position when the serous cavity is filled with fluid, except in those cases of *inversio testis* when it has a reverse position.

The blood-vessels and ducts are connected with that part of the testis where the visceral layer of its serous covering is reflected off—i. e., along the posterior border.

Vessels and Nerves.—The *blood-supply* of the two layers of the scrotum is more or less independent as is that of the testis. The external layer is supplied by branches of the external pudic and the superficial branch of the internal pudic. The deeper layer is supplied by the cremasteric artery and the artery of the vas deferens, leaving the spermatic artery and some branches of the artery of the vas deferens to supply the testis. The *veins* accompany the arteries. The *nerves* which supply the scrotum come from various sources, including the ilio-inguinal and ilio-hypogastric, the superficial perineal branch of the internal pudic nerve, and the inferior pudendal, a branch of the small sciatic. These supply mostly the skin and dartos. The cremaster muscle is supplied by the spermatic branch of the genito-crural nerve. Irritation of the cutaneous branch of this latter nerve causes a reflex contraction of the muscle known as *cremasteric reflex*.

The *lymphatics* of the scrotum pass to the inguinal glands. Although the blood and nerve supply of the scrotum is abundant, its vitality is not great, so that it sloughs from inflammation or pressure; therefore it is advisable to be careful in strapping.

The scrotum is, furthermore, one of the first parts to show œdema, and the most frequent seat of elephantiasis.

IX. THE TESTICLES.

The *testes* are suspended in the serotal pouch by means of the cord, and their attachment to the tunica vaginalis, at unequal heights, that of the left side being usually lower than the right.

Shape.—In shape they are ovoid, compressed somewhat laterally. They thus present two surfaces, internal and external; two borders, anterior and posterior; and two extremities, superior and inferior.

As to **SIZE**, they average one and a half inch long, one and a quarter inch from front to back, and about an inch transversely. The left is often a little the larger of the two, the average **WEIGHT** varying from three quarters to one ounce.

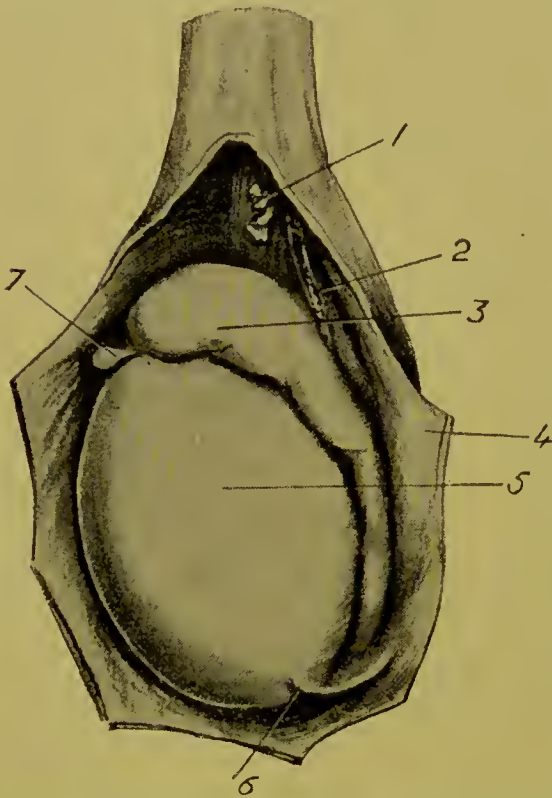


FIG. 25.—Left tunica vaginalis opened, showing testis, epididymis, etc., from outside. 1, organ of Giralès; 2, vas deferens; 3, epididymis; 4, 6, tunica vaginalis; 5, testicle; 7, hydatid of Morgagni. (Quain.)

Position.—The testis is suspended obliquely, so that its upper end points somewhat obliquely outward and forward as well as upward. Thus, the posterior border looks also upward and slightly inward, the anterior border in the opposite direction; and the outer surface is inclined somewhat downward and outward, the inner surface in the opposite direction. The testis is normally fixed to the posterior and inferior part of the tunica vaginalis, and retains this position when the latter is filled with fluid. In the cases of so-called *inversion of the testis* its position is directly opposite, in the front and lower part of the serotum, as if it were rotated on its verti-

cal axis through one hundred and eighty degrees. The testis may also be retained in the abdominal cavity, or in the inguinal canal in its passage into the serotum. On the other hand, it may pass through the serotum into the perinaem, by the continued traction of the gubernaculum, or it may pass through the femoral instead of the inguinal canal.

The lower position of the one testis, usually the left, prevents compression of the two together when walking, etc.

The consistence of the testes is everywhere equal, so that any hardness is pathological.

The Epididymis.—This is made up of convolutions of the first part of the excretory duct of the testis, is attached to the posterior border of the latter, and rests on its outer surface, anterior to this border. Its enlarged upper end, called the *head* or *globus major*, projects slightly forward as it rises a little above the upper end of the testis. The *body*, or middle portion, rests against the back of the outer surface of the testis by its concave internal surface. The convex outer surface and the anterior border are free. Along its posterior border we find the line of reflection of its serous covering, which connects it with the testis and the two with the parietal layer of the tunica vaginalis. The lower end, smaller and more pointed than the upper, is known as the *tail* or *globus minor*, and ends in the beginning of the vas deferens.

The epididymis is directly connected to the testis at the upper and lower ends of its concave internal surface, and between these points by a reflection of tunica vaginalis from their posterior borders, which forms a pouch (digital pouch) between the two bodies.

The *hydatids of Morgagni* are found at the front of the globus major, and more to its outer side. They are pedunculated, covered by tunica vaginalis, and consist of connective tissue and vessels. One or more may occur, but one is regularly present, pyriform in shape, and lies between the globus major and the testis. They represent remains of the ducts of Müller.

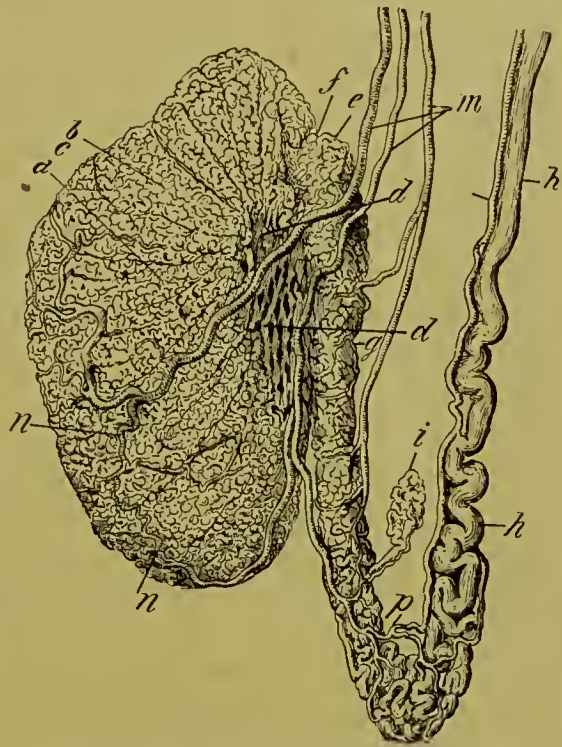


FIG. 26.—Injected testis, epididymis, and vas deferens. *a*, body of testicle; *b*, lobules; *c*, vasa recta; *d*, rete vasculosum; *e*, vasa efferentia; *f*, coni vasculosi; *g*, epididymis; *h*, vas deferens; *i*, vas aberrans; *m*, branches of spermatic artery; *n*, ramification in the testis; *p*, union of the vas deferens artery with a twig of spermatic artery. (Quain.)

Structure.—The outer or *serous* coat of the testis and epididymis forms a complete covering for each, except along their posterior borders, where the visceral tunica vaginalis is reflected off to become continuous with the parietal layer. At the upper and lower ends of the internal surface of the body of the epididymis it is also connected directly with the testis. Along the posterior, free border of the testis, above, we have the ducts

passing out which go to form the epididymis ; just below this the blood-vessels enter the gland ; and at its lower end the tunica albuginea of the testis is firmly connected with the infundibuliform, or *fascia propria*, of the scrotum.

The *tunica albuginea* of the testis is a firm, thick, white layer of fibrous tissue covering the testis beneath its serous coat. It is owing to the firm, unyielding character of this coat that in inflammation of the testis the swelling occurs so slowly, but is accompanied by so much pain ; and also that hernia testis may occur when this coat is once perforated. Along the posterior border of the testis the tunica albuginea projects into the gland as a vertical, median, fibrous septum, *mediastinum testis* or *corpus Highmori*, broader above than below. From this corpus Highmori numerous incomplete fibrous septa radiate out to the inner surface of the tunica albuginea, dividing the organ into three hundred to four hundred conical compartments. A vascular network, supported and connected by areolar tissue, lines the inner surface of the tunica albuginea and the fibrous septa, and has been called the *tunica vasculosa*.

The *glandular substance* of the testis consists of as many conical lobes as there are compartments (three hundred to four hundred). In each lobe there are two or more convoluted *tubuli seminiferi*. These tubules when straightened out are two feet or more long ; they present small bulgings near their commencement, and frequently communicate with one another laterally at their distal ends. They number between eight hundred and nine hundred, and measure $\frac{1}{100}$ to $\frac{1}{50}$ of an inch in diameter. As the tubuli seminiferi approach the corpus Highmori they unite into a smaller number of tubules, which, becoming straighter, are for a short distance close to the mediastinum, called *tubuli recti*. These split up into a network of channels in the mediastinum, known as the *rete vasculosum testis*, from the upper and back part of which the secretion of the testis is conveyed away by the *vasa efferentia*. These, twelve to twenty in number, perforate the tunica albuginea along the upper part of the posterior border of the gland, and, becoming convoluted, pass upward as a number of cone-shaped bodies, which open above into the single tube of the epididymis at intervals of about three inches. These cone-shaped masses of the efferent tubes, known as *coni vasculosi*, form a portion of the head of the epididymis.

The single *canal of the epididymis* is very much convoluted, so that on being unraveled it is found to measure twenty feet or more in length. Its convolutions, which are grouped more or less into lobules separated by imperfect septa, pass from the globus major to the globus minor of the epididymis, and are there continued into the *vas deferens*. The canal of the epididymis decreases in size toward the globus minor, but increases again before becoming the vas deferens. Connected with the lower part

of the epididymis is generally found the *vas aberrans*, a narrow, blind, convoluted tube, two to fourteen inches long, often dilated at its distal end, and sometimes branched. It resembles the vas deferens in structure, and may be connected with the Wolffian duct of the fœtus in origin.

The walls of the tubuli seminiferi in the testis are composed of several layers of cells, the inner forming the basement membrane, being alone complete. This basement membrane is continued in the tubuli recti, but the rete vasculosum testis has no proper wall. The wall of the vasa efferentia and epididymis contain some muscle-fibers, and become thicker as we approach the vas deferens.

The *mucous membrane* of the tubuli seminiferi comprise several layers of epithelium, of which the outer alone is regular and complete. In the internal or nutritive layer lie imbedded the heads of the spermatozoa. In the tubuli recti the mucous membrane consists of a single layer of cubical or flattened cells continuous with the outer complete layer of the tubuli seminiferi and with the single layer of flattened cells in the rete vasculosum testis. In the vasa efferentia and the epididymis the columnar cells are ciliated, the movement of the cilia being toward the vas deferens. In the globus minor, near the vas deferens, the cilia disappear.

Vessels and Nerves.—The *spermatic artery* supplies the testis and epididymis, together with a few small anastomosing branches of the artery of the vas deferens. Their point of entrance is along the posterior border, at which point also the several branches of the *spermatic vein* pass out, and unite together into a plexus, the *pampiniform plexus*. The *lymphatics*, beginning as intercommunicating spaces between the tubuli seminiferi, accompany the spermatic vessels and terminate in the lumbar glands. The *nerves* are derived from the sympathetic, and come mostly from the aortic plexus along the spermatic vessels, forming the *spermatic plexus*. A few filaments come from the hypogastric plexus along the artery of the vas deferens.

Spermatic Cord.—This consists of the following structures, which are grouped together by delicate areolar tissue in their passage from the internal abdominal ring to the upper end of the testis. They have the same coverings as the testis while they are contained in the serotum, except for the tunica vaginalis, which is often found represented by a fibrous cord among the other structures of the cord. Above, the dartos covering is replaced by superficial fascia, subcutaneous connective tissue intervening between it and the skin. The spermatic fascia extends only to the external abdominal ring, to be there continued as the aponeurosis of the external oblique muscle. The internal oblique muscle also takes the place of the cremaster layer in the inguinal canal. Briefly described, the cord in the inguinal canal is bounded in front by the aponeurosis of the external oblique muscle, and to a slight extent, externally, by the muscle-

fibers which form the conjoined tendon; behind, by the transversalis fascia, and below or internally by the conjoined tendon; below, by the union of the aponeurosis of the external oblique with the transversalis fascia; and above, by the conjoined tendon and its muscle.

The structures forming the cord are as follows: (1) vas deferens; (2, 3) the spermatic artery, and the artery of the vas deferens; (4) the spermatic plexus of veins; (5) the sympathetic nerve-fibers; (6) lymphatics. The cremaster muscle, its artery, and the genito-crural nerve belong properly to the coverings of the cord.

The *spermatic plexus of veins* (or *pampiniform plexus*) is divided into two groups: (1) a larger group, placed anteriorly with the spermatic artery; (2) a smaller group, with the artery of the vas deferens lying more posteriorly. It is the former only of these two groups which is to be included by the ligature in operating for varicocele. Above, the veins form two or three trunks, which passing into the abdomen unite to form a single trunk, which empties into the vena cava on the right side, the renal vein on the left.

The following are some of the anatomical reasons for the frequency of varicosities in the spermatic veins: their length, dependent position, vertical course, large size as compared with the arteries, few and imperfect valves, and tortuosity. Further, they lack external support, being in a loose tissue, and are exposed to pressure in the inguinal canal.

The *vas deferens* continues the canal of the epididymis, and ascends on the inner side of the epididymis, from which and the posterior aspect of the testis it is separated by the spermatic vessels. It then forms one of the elements of the spermatic cord, and ascends almost vertically to the external inguinal ring, lying behind the other structures of the cord, except in inversion of the testis, when it lies in front.

From the external ring it passes upward and outward to the inner margin of the internal inguinal ring, where in turning inward it forms a crescentic margin in the infundibuliform fascia; it then turns sharply inward and downward into the pelvis, across the external iliac vessels, turning around the outer and upper aspect of the deep epigastric artery. It lies beneath the lateral false ligament of the bladder, where it crosses the obliterated hypogastric artery. Having reached the side of the bladder, it arches backward and downward over the ureter to reach the base of the bladder to the inner side of the ureter. Here it lies to the inner side of and parallel to the seminal vesicles, and finally joins with the duct of the latter, near the base of the prostate, to form the common ejaculatory duct. The course of the latter through the prostate has already been described.

At its commencement the vas deferens is rather tortuous; it then becomes straight, and of nearly uniform caliber, but at the base of the

bladder near its termination it is dilated into a large sacculated *ampulla*, resembling a seminal vesicle, and then narrows again before joining with the latter. It measures nearly two feet in length, and one tenth of an inch in its average diameter. The walls of the vas deferens are dense and thick, so that it can readily be detected by its firm, cord-like sensation when pinched. The wall consists of a thick external fibrous coat; a middle muscular coat, the inner fibers of which are circular, the outer longitudinal; and an internal mucous coat. The muscular coat is thick and yellowish, and near the epididymis there is an additional thin longitudinal layer. The mucous membrane shows three or four longitudinal ridges. The epithelium is columnar, and not ciliated. In the *ampulla* occur tubular mucous glands, and in many other respects this part resembles the seminal vesicles.

(For the anatomy of the seminal vesicles, see the article on THE SEMINAL VESICLES.)

DISEASES OF THE PENIS.

By RAMON GUITERAS, M. D.

ABNORMITIES OF THE PENIS.

Absence of the Penis is rare. Vinogradoff reported the case of a boy seven years of age in whom there was no penis, although the scrotum and testicles were normal. In some cases neither penis nor scrotum are present. In other cases the penis and anus are absent, as in one case reported by Agnew, where a man passed feces from his mouth for a period of forty years. Absence of penis may be due to accident, self-mutilation, wounds followed by sloughing, phagedenic diseases, etc. A case came under my observation at the Charity Hospital, some years ago, of a man thirty-five years of age, who had been suffering from a chancroidal ulceration of the glans penis, evidently phagedenic. He had used a wash prescribed for him by an apothecary. The ulceration, however, continued to extend, and had eaten away his penis up to the pubes, when he decided to enter the hospital, fearing that it might ulcerate into the bladder.

In still other instances the absence of the penis is due to operation, as in the case of eunuchs. There are two classes of eunuchs, the complete and the incomplete. The complete, employed in the harems of the East, are castrated when small, either by amputation or by tying a ligature about the genitalia close to the pubes and then placing them in sand-holes until gangrene and slough of the genitals follow. This is a very dangerous procedure, and the majority of the children die from its effects.

The incomplete or simply castrated eunuchs were principally among the Italians, where they were formerly seen as soprano singers. The operation is still performed among certain sects in parts of Russia and Roumania.

Rudimentary Penis.—Instances of this abnormality are often seen. Dr. Joseph Jones, of New Orleans, reported a case in which the penis was but an inch in length, the testicles and scrotum being absent. In other cases where the penis is absent and the scrotum present this defect is generally due to an imperfect fusion of the septum between the anterior or uro-genital and the posterior or anal portion, thus producing a broken or bridged condition of the cloacal wall. This not only accounts for the

absence of the penis from the nonappearance of the genital eminence, but also for the displacement of the urethra, so that its orifice is in the rectum or some fold in the skin.

Concealed Penis.—This is occasionally observed in infants, either beneath the skin folds of a cleft scrotum or buried beneath the fat of the mons. In these cases careful examination will reveal it as a small, firm cylinder.

The operative measure consists of an incision made through the overlying tissues, thus liberating the organ—flaps sufficient to cover it being taken from the adjoining skin.

Multiple Penis.—Such cases are rare. They may be situated either beside one another, over one another, or separated from one another. The functions of urination and copulation are generally intact. The case reported by Ernest Hart (*Lancet*, 1866) was a very interesting one. A strong, healthy man had a withered thigh, leg, and foot between his thighs. In front of this was a scrotum, and on either side testicles and a penis, all in thorough working order.

Imperfect or Deformed Penis.—The two principal varieties of imperfect and deformed penis are those connected with hermaphroditismus and hypo- and epispadias. True hermaphroditism—i. e., when one side has the male germinal gland, the testicle, and the other the ovary—are rarely if ever seen, the cases which come principally to our notice being those of the spurious variety, which are very puzzling at birth, in that the organs belonging to both sexes seem to be present. For instance, a male with a cleft scrotum, undescended testicles, and a diminutive, hypospadiac penis, with the urethral opening in the perinæum, closely resembles a female with elongated clitoris and an atresia vagina.

The following cases, one of true the other of pseudo hermaphroditism, illustrate the characteristics of the two conditions:

Case of Lukomsky.—Patient thirty years of age; penis two inches long, without urethra, below which was a scrotum with two testicles. Below the scrotum was a normal vulva, with a labia majora, minora, and clitoris, beneath which was discovered the urethral opening. The vagina was about three inches in length, with a normal uterus and cervix. The patient had never menstruated. In having coitus with a female, a whitish fluid was ejaculated through the vaginal slit.

Boudareff's Case.—Patient thirty-five years of age; genital slit about one and one fourth inch. Labia majora contained oval bodies resembling testicles, with spermatic cords running from them into the pelvis. Labia minora small, resembling continuation of prepuce of clitoris. Clitoris was two and a half inches long and two inches in circumference. It contained no urethra. The urethral orifice was at the upper angle of the vaginal opening, and admitted two fingers, through which the patient probably had intercourse. The vagina was shallow, measuring a little over an inch, and ending in a rudimentary uterus. Patient had never menstruated.

From the numerous cases of true and pseudo hermaphroditismus quoted by different authors, certain conclusions may be drawn :

1. That the greater part of these are cases of hypospadiac males.
2. That the predominating sex should be carefully searched for and decided upon by physiological as well as anatomical observations ; that in so doing the two principal signs to be considered are, the presence of menstrual fluid, or a discharge from some point of a whitish fluid containing spermatozoa.
3. That too much importance should not be attached in adult life to their male or female characteristics and sexual affinities, as these are governed to a great extent by the sex according to which they were brought up.

Treatment.—Careful examination having been made and the predominating sex decided upon, surgical interference should at once be instituted to correct, if possible, by plastic work the existing state of affairs, and to favor the healthy development of the parts by freeing them from any tissue tending to induce the deformity by its interference ; also, to cover over or remove any crevices or tissues which are of no other use than to disguise or deform the true sex. In some cases, where it is uncertain which functions will predominate, it is better to wait and perform simple temporary operations until further developments take place.

Malformation and congenital defects of the sexual organs are generally accompanied by imbecility, idiocy, and epilepsy. Bourneville and Sollier, from a careful study of a large number of these cases, reported that of 223 under thirteen years of age, 164 were idiots, while 59 were idiotic and epileptic as well. Of 505 cases over thirteen years of age, 172 were idiotic and 333 were affected with epilepsy. The cases were principally those of phimosis, hypospadias, atrophy of testicles, ectopy of testicles, and bell-clapper glans.

Undersized Penis is a condition occasionally found where, although the organ is perfectly formed, it is not large enough to permit of satisfactory connection. In such cases the organ may be enlarged by the use of various forms of apparatus which have been invented for this purpose, the object being to increase the amount of blood in the part, and thus favor hypertrophy.

Oversized Penis is a condition which often causes a great deal of trouble to the possessor. First, because, if he leads a dissipated life, he is in constant danger of having its tissues torn, and therefore infected through coitus ; and, secondly, because he is liable to injure the organs of those with whom he may cohabit.

INJURIES TO THE PENIS.

Wounds of the Penis.—The classification is the same as for wounds of other parts.

Incised wounds are generally made with knife or razor by jealous women, or by monomaniacs for the purpose of self-mutilation. They are often irregular on account of the tough, trabecular nature of the tissue and the extreme mobility of the part.

Lacerated wounds are not common; they are most often due to the organ being caught in machinery.

Punctured wounds are also rare, except in time of war, from sword and bayonet thrusts.

Contused wounds are caused by blows, kicks, jams, and similar accidents. They are often serious, and are liable to be complicated with fracture of the penis or rupture of the urethra.

Strangulation is generally classified with this condition. It has been observed in boys suffering from incontinence of urine or seminal emissions, from tying a string around the organ as a preventive. If the resulting strangulation is not relieved, the string may cut through the urethra, or gangrene and slough of the penis may result. Oftentimes after the string has been removed a band of ulceration remains, which may give rise to a cicatrix, interfering with the function of the organ. Strangulation may result from other causes. Mr. Potts reported the case of a man who came to him with his organ greatly swollen and discolored, the glans being quite black. About two thirds back on the organ was a ring deeply imbedded, which had been slipped over it by some woman a few hours before. This was filed off by passing a director beneath it.

A peculiar case was observed at the Chambers Street Hospital some years ago. A man had, for some unaccountable reason, put his penis in a bottle. Strangulation ensued, and he entered the hospital some hours afterward wearing the bottle. The part of the penis within the bottle was very much swollen and congested, and the organ was liberated with great difficulty.

Gunshot-wounds of the penis are rare, occurring usually in time of war. The urethra may be injured, or a part or the whole of the penis may be carried away.

Treatment.—The three dangers to be guarded against are hæmorrhage, urinary infiltration, and curvature as the results of a wound of the corpora cavernosa. In all cases wash, cleanse, and thoroughly remove any *débris*. Ligate severed vessels, and approximate and sew up incised wounds with silk or wire. If the urethra is cut, its edges should be brought together and a catheter retained. The subject of urinary infiltration is treated

elsewhere. From all these wounds cicatrices causing curvature, as in cases of fracture, may occur, the curve depending on the site of the wound.

Fracture of the Penis is generally due to injuries received when the organ is in a state of erection, by "missing the mark," as Bryant aptly terms it, when in coitus the penis strikes the outer wall of the vulva or the pubes; or it may occur in relieving a chordee by a blow—"breaking the chordee," as it is termed. In this manner a traumatic stricture may be caused. Fracture of the penis is followed by pain and induration in one or both of the corpora cavernosa. Later an atrophied condition at this point, which interferes with a complete turgescence of that side, may result in lateral curvature.

Fracture of the penis may be complicated with rupture of the urethra, in which case there is often an abundant urethral hæmorrhage. Fracture of the corpus spongiosum may occur as well, though this is rare. Bryant mentions the case of a boy nineteen years of age who was bitten by a horse, entirely severing the corpus spongiosum, which prolapsed from the urethra as a fleshy mass. This was of no special inconvenience, the urine escaping by its side.

Treatment.—Rest in bed should be enforced, applications of cold water or solution of lead and opium; pass and retain gum-elastic catheter. If œdema and swelling are great and slough threatens, full incisions may be resorted to. The organ should be kept elevated.

Dislocation of the Penis.—Malinowski reports a case in an adult where the penis was dislocated into the scrotum by mechanical violence and remained there for four months. It was then liberated and replaced with its own integument patched out with serotal. The power of coitus quickly returned.

J. B. Field reports a case where the penis and both testicles were dislocated up under the abdominal integument above Poupart's ligament.

A. P. Hill reported the case of a boy who was caught in a hay-rake, lacerating his scrotum and perinæum, and dislocating his penis upward under the integument of the linea alba. This was not discovered until retention of urine set in. The sheath of the penis was then split up and the organ fished down into place.

CUTANEOUS AFFECTIONS.

Cutaneous affections of the penis may be classified as acute and chronic. The acute embrace eczema, erysipelas, scabies, and herpes; the chronic include lupus, tuberculosis, epithelioma, and verruæ. Of these, herpes, epithelioma, and verruæ will be considered elsewhere. There are other affections, acute and chronic, which, though involving the skin, will for the sake of classification be considered later, as lymphangitis, adenoma, elephantiasis, etc.

Eczema.—Eczema of the penis may be either of the erythematous or vesicular form. Where scrotum and penis are both affected it is apt to be chronic and very rebellious, and is often accompanied by phimosis and enlargement of the inguinal glands. It is generally found in men between the ages of thirty and fifty, who are of a catarrhal, gouty, or rheumatic diathesis. Its favorite seats are the prepuce near the margin and the base of the penis. Eczema of the prepuce is generally subacute, and occasioned by the rubbing of the organ against the underclothing or other ill-fitting garments. When accompanied by an inflamed and infiltrated base and enlarged glands in the groin, it often causes considerable anxiety to the patient, especially if it occurs soon after a suspicious coitus, as he is very apt to fear that he has the initial lesion of syphilis. Eczema may appear on the inner layer of the prepuce instead of the outer. Eczema of the base of the penis is generally chronic and slightly infiltrated. It may cause very little inconvenience for months or years.

Treatment.—The acute variety is best treated by powders. The patient should be directed to wash the surface twice a day with hot water, and afterward to sprinkle on a powder consisting of boracic acid, bismuth, and lycopodium or starch. In some cases, after sprinkling with the powder, I lay over it a soft piece of sheet lint covered with vaseline. Eczema in this location, as elsewhere, is often due to faulty excretion of the kidneys or an accumulation of excrementitious matters in the blood in individuals of a gouty or rheumatic diathesis. Considerable assistance may be derived from the use of acetate of potash, grs. xv, t. i. d. Inflamed or enlarged inguinal glands should be painted with iodine.

In the chronic variety, such as occurs about the base of the penis, ointments seem to be most efficacious; and as it is necessary in these cases to resort to mild stimulation, good results are often obtained by adding oil of cade, one half drachm to one drachm to the ounce of zine oxide, Lassar, or diachylon ointment. If much moisture exist, dust on the powder above mentioned.

Scabies.—Scabies is the cutaneous affection which causes perhaps more alarm than any other acute nonvenereal lesion found on the penis. The lesions may be either papular or pustular. A patient with one or two papules or pustules on the organ, enlarged glands in the groin, and an eruption on the body, may believe that he has syphilis, especially if he happened to have a sore throat, a cold, or malaria at the same time. Careful examination, however, would at once show the difference. The eruption of scabies itches, and is acute and irritable. The presence of burrows is an important diagnostic sign, the most typical of which are found on the penis and between the fingers. The lesions of this disease on the penis at times resemble moist specific papules or mucous patches, for which they are often mistaken.

Treatment.—Wash with soap and water, and apply the following ointment: Carbolic acid, ten grains; oil eadini, one half drachm; ung. sulph., one ounce. Scabies of the rest of the body should be treated in the same way every night for five nights, and the patient should be directed to put on fresh linen every morning.

Lupus.—Lupus of the penis is a rare affection. The erythematous variety is differentiated from epithelioma, with which it is very often confounded, by the duration and slowness of the disease, the eharacteristic sealing, and the presenee of eieatrieial tissue in the places that have already been invaded. Lupus vulgaris differs also in duration, being a disease beginning during boyhood or youth, while epithelioma is a disease of old age. Lupus advanees slowly, leaving eicatrices behind it; while epithelioma advanees more rapidly, quickly tending to glandular involvement and uleeration.

Tuberculosis of the Penis is an exceedingly rare disease. Kraske has recently reported a ease of this kind in a man forty-nine years of age, who had tubercular-looking ulcers on his glans. Amputation of the organ was performed, and a mieroseopical examination confirmed the diagnosis, both typical giant eells and tuberele bacilli being found. The growth was more marked deep in the substance of the organ, thus showing that the infeetion was not a surface one.

LYMPHATIC AFFECTIONS OF THE PENIS.

The various lymphatie and suppurative inflammations of the penis, lymphangitis, lymphitis, abseesses, phlegmon, erysipelas, etc., are elosely allied, in that the infeeting material is introduced through the lymphatie channels and the inflammation begins around them.

Lymphangitis.—In one variety of lymphangitis a hard eord appears on the dorsum of the penis, the result of aente inflammation, as gonorrhœa. This afterward becomes reddened, painful, and tender, and is followed by enlargement of the inguinal glands.

There is another form of lymphangitis, in which the lymphaties on the side of the penis become very much enlarged, and often the whole organ is swollen, red, and inflamed. When the lymphatic inflammation becomes so great that suppuration takes plaee, the pus is generally discharged through the prepuce, coming out from its inner side.

Still another variety of lymphangitis, known as virulent lymphitis, occurs generally in eonnection with ehaneroids, in which case the virus sets up an inflammation in the lymphaties of the penis before they reach their terminal ganglia.

Treatment.—Lymphangitis of the penis should be treated during the aente stage by lead and opium wash, hot or cold water, and elevation of the organ. If suppuration threatens, poultice; if eellulitis develop, poul-

tice, open, and treat as cellulitis elsewhere. In cases of lymphitis, with virulent abscesses, open and treat as buboes.

Abscess of the Penis may develop, as elsewhere on the body, with no apparent cause. I remember the case of an Italian, possessing an unusually large organ, on the left side near the middle of which was an abscess one or two inches in diameter and one half inch in height. The man was otherwise in perfect health, and not suffering from any venereal disease.

Treatment.—Poultice, until fluctuation takes place, then open and dress antiseptically.

Cellular Inflammation of the Organ, or Penitis, is of rare occurrence, and usually complicates some other existing disease. It is generally diffuse, and occupies the lower part of the organ, which is very much swollen, reddened, and infiltrated, with more or less marked fluctuation. There may be a considerable elevation of temperature.

Treatment.—Poultice; quinine tonics; open when fluctuation takes place, and treat antiseptically.

Periurethral Phlegmon is a little abscess occurring in the cellular tissue beneath the urethra. It may develop anywhere along the penile portion of the urethra, although the most frequent seats are over the fossa navicularis and at the peno-scrotal angle. It is generally due to a very acute urethritis, or to neglect or over-indulgence during an attack. The phlegmons vary in volume from the size of a pea to that of a walnut; the larger ones usually occur about the peno-scrotal angle. They develop rapidly, and break, if not lanced, leaving a deep hole behind; occasionally they undergo resolution.

Treatment.—Poultice until fluctuation is observed, then open and wash with antiseptic solution; after this treat with astringent powder, iodoform, or aristol; or by keeping on a piece of cotton soaked with lotio nigra, aromatic wine, or 1-to-2,000 bichloride solution over the opening. Cauterize the base every second or third day until it looks healthy.

Folliculitis.—This is ordinarily a chronic process. In cases of chronic urethritis one of the follicles of Morgagni becomes inflamed, and its lining membrane hypertrophies, thus occluding the duct. The secretion of the follicle, and perhaps some pus, accumulate in this sac, which continues to grow slowly like a sebaceous cyst. This may remain indolent for a time, when, on account of some irritation, it will inflame, discharge its contents, and leave a fistulous opening behind.

Treatment.—Open, and treat antiseptically.

Erysipelas of the Penis may occur here as elsewhere, either primarily in the organ or secondarily through extension from the surrounding tissues. This generally terminates in resolution, but it may result in suppuration or even in gangrene.

Treatment.—Lead and opium wash locally every two hours. Tincture of chloride of iron and some saline diuretic internally. If it goes on to suppuration or gangrene, treat accordingly.

Gangrene of the Penis is a rare condition, depending upon some mechanical constriction, a condition of phimosis or paraphimosis, phagedenic ulceration of the organ, or urinary extravasation. Again, it may follow the exanthematous fevers, especially small-pox and typhoid fever, or it may be due to poisoning by ergot. There are swelling and discoloration of the organ, followed by diminished sensibility; a line of demarcation is formed, and a sulcus behind this, through which urine escapes.

Treatment.—Good diet. Charcoal poultices till part sloughs off; then treat as an open sore.

TUMORS OF THE PENIS.

These may be either malignant or nonmalignant.

The nonmalignant tumors are cystic (mucous or sebaceous), adenoma, fibroids, vascular tumors, and elephantiasis.

Mucous Cystic Tumors are rare; they may occur anywhere on the balano-preputial mucous membrane. Sebaceous cysts may occur in any region where sebaceous glands are present.

They should be treated like wens in other localities.

Vascular Tumors are of three kinds—capillary, as *nævi*; venous, as angiomas; and arterial, as erectile. Of these, the most common variety is the venous or the varices, found on the dorsum, consisting of large, soft masses of tortuous veins. They have been reported of such a size as to interfere with the proper erection of the organ.

Treatment.—Excision, and treatment by means of the galvanic current, produce the best results. Parona reports three cases of varix of the dorsal vein cured by injections of half a gramme of saturated solution of chloral hydrate.

Capillary and arterial tumors are exceedingly rare.

Fibroid Tumors usually occur upon the body of the penis, either on the side or on the dorsum. They are probably due to a plastic effusion into the trabecular structure of the corpora cavernosa, and a fibroid development as a result.

Marcus Beck reports the case of a man fifty-three years of age, healthy and robust, who had on the left side of the penis, below the glans, a tumor about the size of a hen's egg, irregular and nodular in shape. Its base almost surrounded the penis. It was very hard, and free from pain. The lower part of the tumor was in an ulcerated condition. Thirteen years before, a warty growth was discovered on the inner side of the prepuce near the base of the glans. In two years this had reached the size of a walnut. Circumcision was then performed, removing the growth. Two years later a tumor developed in the cicatrix. This grew slowly until six months ago, when it began to develop rapidly, interfering

with coitus, though not with micturition. Amputation of the penis was performed. The growth was found to be continuous with the corpus spongiosum and the corpora cavernosa, evidently arising from the latter. Microscopically it showed a delicate, white, fibrous structure.

Elephantiasis of the penis may occur alone, but it is generally associated with that of the scrotum. In this case it may assume a large size, or it may become completely hidden in the enlarged scrotum, only a small hole remaining for urinating, etc. After an operation, however, the penis recovers its former activity. The literature on this subject is exceedingly limited. I have seen but one case, that of R. W. Taylor, of New York city. It occurred in the prepuce of an old soldier, as a result of a former wound of lymphatics on the dorsum of the penis near its base, received in the late war. The growth of the prepuce progressed slowly, and when the patient presented himself was about the size of a duck's egg. Circumcision was performed, giving very good results, the integument of the body of the penis being very slightly involved.

M. Trippier, in the *Gazette Médicale* of 1836, described the case of a young man suffering with elephantiasis of the penis, which had been growing for thirteen years. At date the organ was nine inches in length and seven in circumference. This case was occasioned by a carbuncle, which had interfered with the lymphatic circulation of the organ.

Adenoma of the penis is rare, the following being the only case which has ever come under my observation :

Man, thirty-four years of age. No venereal history other than that of a urethritis eighteen years ago. Two years previously he noticed that his prepuce was swollen and œdematous; the inflamed condition became gradually less diffuse and more nodular. The skin of the prepuce and body of the penis contained several small subcutaneous tumors about the size of a pea or marble, and also cysts containing a thick, mucilaginous fluid. The inguinal glands were enlarged.

Horny Growth of the penis is comparatively rare. An interesting case was reported by J. H. Brinton, in the *Medical News*—that of a farmer, sixty-two years of age. The horny growth sprang from the base of the glans and body of the penis. It was one and seven eighths inches in length, and one and three eighths in circumference at its base. There was also a plate of horny tissue encircling the end of the glans penis, surrounding and narrowing the meatus. The frænum was gone. The horn was striated like an exaggerated thumb-nail, and when dry of a smooth, polished appearance.

Malignant Tumors of the Penis.—Cancer and sarcoma are most common.

Scirrhus cancer occasionally occurs, but is very rare; the more common form is epithelioma.

Epithelioma of the penis usually develops as a arty growth, most frequently situated on the inner side of the prepuee near its margin, or near, or at the suleus. This causes very little pain or annoyance, as it is at first superfieial and its growth slow. Soon, however, sufficient infiltration oeeurs to make the retraeting of the prepuee difficult, and finally eomplete or partial phimosis exists, and yet the patient has no disagreeable symptoms, execepting perhaps a few vague pains in this locality. A little later, however, an offensive iehorous discharge takes plaee from beneath the prepuee; painful erections oeeur at night, followed by a bloody tinge to the discharge, with an area of induration beneath the prepuee. The disease oeeurs in men of middle or past middle age, perhaps caeheetic, but often strong and lusty; the inguinal glands may or may not be enlarged. Epithelioma spreads slowly, involves the lymphatics slowly, and infects the general system still more slowly. In the further progress of the ease uleeration takes plaee, the lymphatics beecome infiltrated, enlarged glands appear in the groins, and amputation is imperative. If this growth is examined mieroseopieally, it will be found to eonsist of epithelial eells, flattened and erowded together, with a tendeney to arrange themselves in nests, and situated in the interstiees of a network of fibrous tissue.

Treatment.—The operative proeedure depends very much upon the stage of development when the patient first seeks advice. There are four operations to ehoose between, depending on the situation, duration, and development of eomplikations of the disease, viz., eireumeision, euretteing, exeision, and amputation. There is no disease of this organ where the variety of operation depends as much upon the surgeon's individual judgment as it does in this one. If the lesion is situated on the prepuee near its margin, of short duration and no eomplikation of the lymphatics, eireumeision should be performed. If situated near the balano-preputial fold, on either the prepuee or the glans, uneomplikated, it may be either euretteed or exeised. A good method is first to eurette thoroughly and eauterize the base; then, if there be a reeurrenee, exeise. If after this a return takes plaee, amputate. If uleeration has begun and is at all extensive, amputate immediately.

A question arises as to the importanee to be attaehed to glandular enlargements. Almost any lesion of the penis in an irritated eondition may give rise to enlarged inguinal glands. The enlarged glands in a ease of this kind may be due to irritation or inflammation, or, on the other hand, to direet eaneerous infiltration. If due to the first, they will subside after removal of the growth. If due to eaneerous infiltration, they should be removed at once.

Methods of amputation are as follows:

1. Ligature by a wire or string, to be tightened every day until

slough of parts takes place. This is an old, crude way, and is not advisable.

2. *Ecraseur*. This is a method formerly advocated in France, but with few supporters in this country.

3. *Galvano-cautery*. This mode of amputation is a very good one, as it controls hæmorrhage at the same time. It should be performed slowly, with catheter inserted in the urethra.

4. *Cutting operation*. In amputation with the knife, it must be remembered that the skin and urethra should be cut longer than the shaft of the penis. This prevents a shrinking back of the urethra, and allows enough loose skin from the shaft to cover the bleeding corpora cavernosa. A good plan is to sew skin and urethra together after the operation. Make a sweeping incision through the organ one half inch in front of the place where we intend to finally amputate, then a dorsal and belly incision in the median line, and dissect up skin-flaps for one half inch. Next secure corpora cavernosa on either side by forceps or ligature, and amputate at the point to which the flaps have been dissected back. We now have urethra and corpus spongiosum left one half inch in length. We amputate the corpus spongiosum, having dissected it from the urethra, which we split up in the median line superiorly and inferiorly and stitch to the skin-flaps on either side, then bringing urethra together again with a stitch above and below. There is no necessity for cutting the urethra one half inch longer than the corpora cavernosa, as one fourth inch will be sufficient.

H. Keller, of St. Louis, advocates uniting by deeply lying transverse sutures both sides of the corpora cavernosa. In this way the two cut surfaces are in apposition, and the sheath of both corpora cavernosa are in contact in front and behind. Then follows a second row of stitches, drawing together the external skin of the penis over the sutured stump. Oozing is thus controlled.

Horteloup, in performing amputation for epithelioma, always removes the inguinal glands on both sides.

Sarcoma of the penis is rare and generally rapidly fatal. It may develop on glans or corpora cavernosa.

Treatment.—Immediate operation.

MORBID CONDITIONS OF THE PREPUCE.

Phimosis is an inability to draw the prepuce back over the glans; and paraphimosis is an inability to draw the prepuce forward over the glans when once it has been drawn back. Phimosis is often congenital; paraphimosis is always pathological.

Phimosis is of two kinds, congenital and accidental.

Congenital Phimosis causes a great deal of irritation in childhood, and

may give rise to serious nervous as well as local troubles. Retention of urine may be due to this cause. As the individual grows older, other complications may develop, such as balanitis, constant itching, pain, inordinate excitability of the organ, frequent erections, erotic dreams, seminal emissions, vesical tenesmus, incontinence of urine, general lassitude, and imperfect development of the testicles and penis. The nervous symptoms which may follow later in life are coxalgia, moral and physical depression, convulsions, epileptiform or other, chorea, inco-ordinate muscular movements, including those of speech, sterility, paresis, hyperæsthesia or a mental condition resembling hysteria or hypochondriasis.

In some cases the whole or a part of the mucous membrane lining the prepuce may be adherent to that of the glans. In still other cases preputial calculi, hard calcareous deposits, may take place in this adherent prepuce, or in the interspaces between the adhesion of the glans to the prepuce. These are easily removed when the prepuce is liberated. In congenital phimosis the organ looks pointed or wedge-shaped, and there is generally abundant loose integument about its end even when the prepuce is adherent. On retracting this tissue, the orifice of the prepuce can be seen as a little, round, tight ring about one eighth inch in diameter, and surrounded by mucous tissue. In the center of this little ring will be seen a vertical slit—the urethra. The redundant tissue resembling mucous membrane surrounding this ring becomes inverted when the pressure of the fingers is removed, and forms a trough, through which the urine escapes.

Treatment.—Circumcision is the treatment for congenital phimosis.

Accidental Phimosis.—This term is applied to the condition when retraction of the prepuce is prevented by inflammation of the balanopreputial fold or swelling of the glans, as in balanitis, or from the presence of new growths or ulcerative lesions, as verrucæ, chancre, or chancreoid.

The treatment of accidental phimosis may be expectant or operative.

Expectant treatment consists in the injection of some astringent, disinfectant, soothing, or cleansing solution beneath the prepuce, to reduce the inflammation; after the subsidence of which, operative procedure may be resorted to. This applies principally to acute accidental phimosis, and that condition of subacute or chronic sluggish thickening following the initial lesion of syphilis.

Operative procedure consists either in circumcision, the dorsal incision, the dorsal excision of the V-shaped piece, or the lateral incisions. The treatment depends also a great deal upon the cause and the acuteness of the attack, and here the physician must rely in a great measure upon the history. Verrucæ or venereal warts are mentioned as the cause of accidental phimosis; they are generally of long standing, coming on slowly,

the acute inflammation being due to some sudden source of irritation. In a case of this kind the physician should inject subpreputially a solution of bichloride 1-10,000 to a 1-5,000, solution of permanganate of potash 1-500 to 1-100, solution of sulphate of zinc 1-100, or carbolic acid 1-100. A solution of borax gr. xx, glycerin 3j, and rose-water ℥j, is a nice preparation and of great efficacy in these cases. When the inflammation subsides and the phimosis is reduced the vegetations may be removed. If the inflammation subsides, but on account of hypertrophy of the verrucae the phimosis is not reduced, make Taylor's lateral incisions, which will give us antero-posterior flaps, and treat accordingly.

In phimosis due to concealed ulcers the prepuce is very much inflamed, swollen, and œdematous. The discharge of pus from the preputial trough is abundant—so much so that in some cases the dripping is almost constant. This pus is often of so rich a color that one might imagine, were it not for the history, that there was an acute attack of urethritis to deal with instead of concealed ulceration. This condition is often difficult to diagnosticate, and must be treated more or less blindly. One thing must be remembered, that however bad the case may appear, or however imperative operative procedure may seem, a few days of quiet, regular life, with a tonic, if the patient's system is below par, and frequent subpreputial irrigations of warm water, followed by astringent injections, will in ninety-five per cent of the cases stop or diminish the amount of the discharge, allow the retraction of the prepuce as easily as before, and permit the regular treatment, as in cases of ordinary superficial ulcerations. Very often the condition may be aided by immersing the organ for fifteen minutes every two hours in warm water, or by enveloping it in soft cloths saturated with *lotio plumbi et opii*, and keeping it elevated.

If no treatment is pursued, the following may result: First, slough of the prepuce or glans; second, ulceration through prepuce; or, third, ulceration through prepuce, with protrusion of the glans. The first of these conditions is rare. It is due to too much pressure, which should be relieved by preputial incisions. The second is due to neglect, or the ulcer having taken on a phagedenic form. The third may be caused by localized sloughing or ulceration through the dorsum of the prepuce. The protruding glans, becoming caught in this hole, is pressed upon by the sides, and an œdematous condition takes place. This may be relieved or reduced by elevation, and constant applications of *lotio plumbi et opii*, or hot-water immersions. When the inflammation and ulceration have subsided, trim off the prepuce at a level with the proximal border of the ulceration.

Phimosis due to simple balanitis and posthitis is not so acute or severe, and more amenable to treatment. Any of the injections first mentioned would probably reduce the inflammation and allow retraction

of the prepuce. In cases of chronic accidental phimosis due to syphilitic or other cicatrices circumcision is called for.

Circumcision was in vogue long before the Christian era, not only among the Jews but among various races on the different continents. It has always been a custom among the Egyptians, Arabians, Turks, Persians, East Indians, North and South American Indians, certain tribes in Africa, Australians, and other South Sea islanders. Among different races it was customary to perform it at different ages—e. g., among the Jews on the eighth day; among the Egyptians from the sixth to the tenth year; among the Arabians when they were about to enter puberty. In olden times the methods of procedure were very crude; the prepuce was generally chopped off with a piece of shell or a sharpened stone.

As the science of surgery has advanced, other and more delicate operations have succeeded these crude methods, and many instruments, clamps, etc., fastened by springs and catches, have been devised to assist the various operative procedures.

In the blades on either side of certain of these clamps are spaces two to three inches in length and wide enough to admit a needle. In others are little holes one fourth of an inch apart and opposite to one another, through which needles may be passed. With an instrument of this kind the quickest method of circumcision can be performed. The prepuce consists of two layers, an upper or integumentary and an inner or mucous, the space between which is filled with cellular tissue. These two layers are attached in front by a margin in common; behind, one is continuous with the skin of the shaft of the penis, abdomen, scrotum, etc., while the other or mucous membrane is made fast behind the corona, and from there extends up over the glans to the meatus.

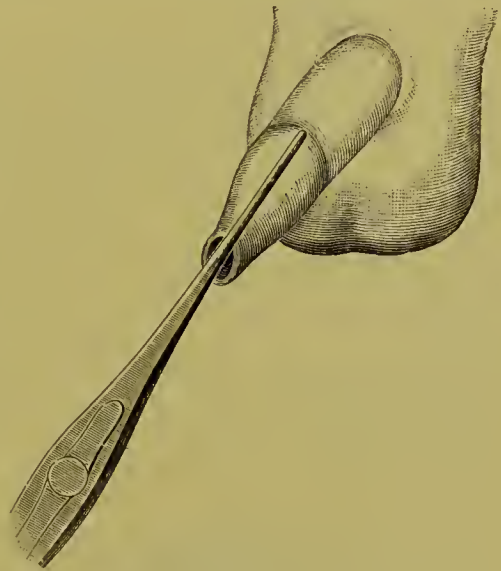


FIG. 1.

The following are a few easy and rapid methods of performing circumcision: 1. Draw the prepuce forward by means of forceps, inserting inner blade up beyond corona and catching mucous membrane firmly as in Fig. 1; put on a clamp, having first determined the line along which the circumcision is to be made; fasten the clamp, pass four stitches through the slit, as in Fig. 2, or eyes, as in Fig. 3, in the blades of the clamp, with scalpel cut off the prepuce above the clamp, retract the prepuce, draw up the stitches in the middle and cut them in two, thus mak-

ing four stitches on each side, or eight in all. If the preputial mucous membrane is adherent, or too tight, slit it up in the median line over the dorsum; tie the sutures on either side, and dress accordingly. This is a

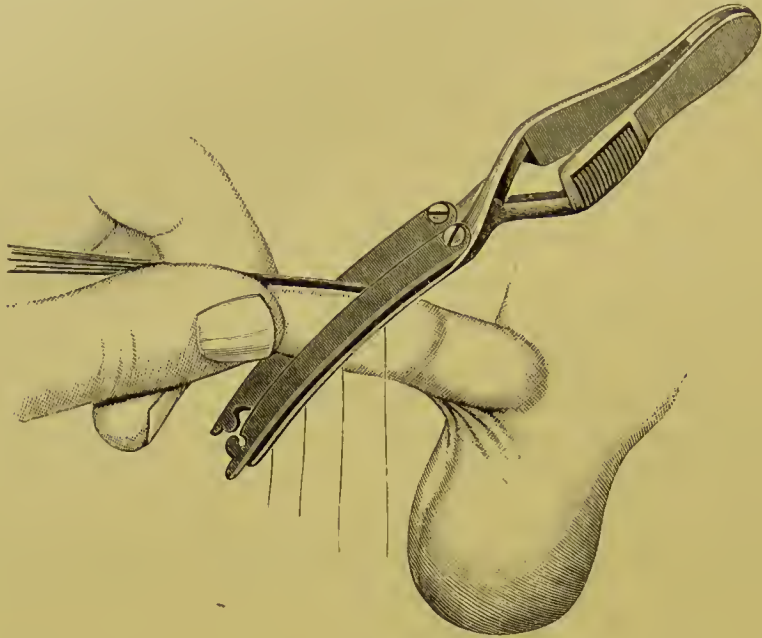


FIG. 2.

quick and simple method, but in order to clear the glans an inch or more of redundant mucous membrane must be left, which detracts from its appearance and leaves a fold of tissue. 2. Catch the preputial margin on either side of the median line of the dorsum with forceps, and draw the prepuce forward; with scissors cut up to the corona through both layers, as in Fig. 4; then, taking forceps No. 1 in the left hand, cut around over the corona to the frænum, as in Fig. 5; then, holding forceps No. 2, cut around on the other side to the frænum. Sew the two layers together on either side by continuous suture. By this method is generally obtained a good result, although occasionally the two sides

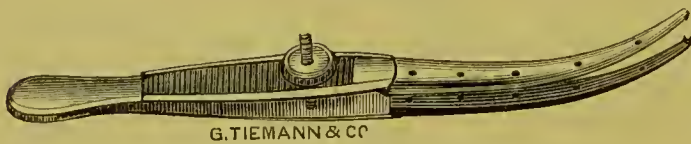


FIG. 3.

are cut unevenly. 3. Before describing my favorite method of performing this operation, which gives the best results, I may say that

circumcision can in nearly every case be performed under the influence of cocaine, if properly employed. Ether is unwarranted and unequalled for. It requires some time—from ten to thirty minutes—to get the patient under the effects of cocaine. I have never seen a case where the parts could not be cocaineized, and that, too, generally by surface applications and subpreputial injections, without resorting to subcutaneous in-

jections into the cellular tissue. I use a ten per cent solution of cocaine, injected subpreputially, and poured on a thin film of absorbent cotton on the outside of the prepuce. Before the operation I mark the proposed line of incision on the organ as it hangs in a flaccid state, allowing for retraction or shrinkage of the skin: beginning at the end I wind the penis with a narrow bandage to the base, where I ligate; patients are more easily cocaineized after the penis has been wound than before, probably because less of the cocaine is carried away into the circulation, and therefore comes more readily in contact with the local nerve filaments. I now adjust my clamp (usually Fisher's, Fig. 3), and cut off the prepuce with a scalpel; I then remove the clamp, allowing the skin to retract, after which I trim the mucous membrane around one fourth inch from the corona, and sew the two cut surfaces together. The first stitch should be a dorsal one in the median line, followed by three lateral stitches on either side between this and the frænum. These sutures should be

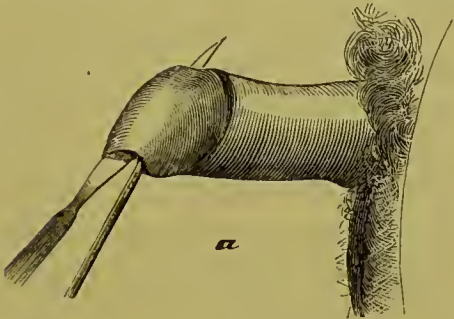


FIG. 4.

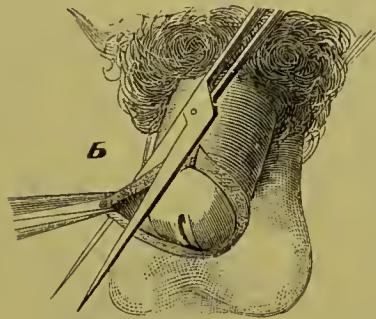


FIG. 5.

either of catgut or fine silk, and, if of the latter, should be taken out in two or three days. Dressing, iodoform gauze. Bandage a piece of oiled silk over the glans, with an aperture through which the urine can be passed without soiling the dressing. Put the patient to bed, with a cradle over the hips; give bromide of potash in large doses, to prevent erections; it generally requires sixty grains, given in fifteen-grain doses, to keep the parts quiet. In this way union by first intention is generally obtained, and a clean-cut surface results.

Palmer, of Louisville, Ky., advocates the dorsal incision in the infant in preference to circumcision, arguing that it is less trouble to the surgeon and the infant at the time of operation, answers all the therapeutic indications, and that atrophy of the unused cover takes place, insuring him in adult life as well finished an organ as if circumcision had been performed. This seems a very rational procedure.

Paraphimosis.—This term is applied to the condition where the prepuce becomes strangulated behind the glans; it may be either reducible or irreducible. It occurs generally in cases of gonorrhœa, chan-

eroid, or chancre, although it may result from nonvenereal causes, even from coitus. A recent condition of this kind is easily reducible, but after a few days a plastic infiltration takes place into the strangulated tissue, adhesions form, and reduction is impossible unless the restricting bands are cut, and even then it is effected with difficulty. The appearance of the organ in this condition is enlarged, the glans swollen, red, and tense. Over and behind the sulcus is a brawny swelling, in some places white, in others pink or red, densely infiltrated, which in old cases has a hard and cartilaginous feel, especially when due to the initial lesion of syphilis. Below this the tissues are inflamed and œdematous, and behind the organ presents a wrinkled appearance. If no treatment is given, ulceration will probably take place through the constricting preputial orifice, thus relieving the strangulation. It may in rare cases result in gangrene, involving the skin and glans, or it may even slough through into the urethra.

Treatment.—First drive the blood out of the organ by squeezing it with the hand or winding it with a narrow bandage, either *in toto* or simply the glans, in order to reduce it sufficiently to push it through the preputial orifice. If this does not answer, bathe the organ in cold water and elevate it. If much œdema is present, scarification may be practiced. In order to reduce it, grease the glans well with sweet oil, working some of it under the preputial constriction, encircle the body of



FIG. 6.

the penis with the thumb and forefinger of the left hand, as in Fig. 6, grasp the glans between the thumb, index, and middle fingers of the right hand, and squeeze until bloodless; then proceed to work the finger-nails under the preputial orifice or constriction, all the time squeezing the glans, and continue pressure until the fingers as a wedge have pushed themselves through the preputial constriction, with the glans penis between them. Various writers have advocated certain instruments to assist in this reduction by inserting them under the constriction and prying it up, as by hairpins, directors, etc.

Forceps have also been made especially to compress the glans so that the prepuce may slip over. Various local applications have also been advocated to assist in reducing this condition, as belladonna ointment, etc.

When the paraphimosis is irreducible, hot water is of the greatest assistance in promoting absorption of the infiltration. I direct the patient to hold the organ in water as hot as he can stand every two hours for

ten or fifteen minutes, and then keep it elevated. If any dangerous complications threaten, such as gangrene or extensive ulceration, the constricting bands should be cut at once. To do this, take a bistoury and insert it under the preputial orifice, with the blade flat, and, having brought it into the median line, cut upward, thus severing the constriction. After an old paraphimosis which has been accompanied by a good deal of infiltration has been reduced, a thickened mass of hypertrophied tissue often remains behind. This can be removed, as suggested by Mauriac, by making two elliptical incisions on either side of the hypertrophied tissue, cutting out the mass and then bringing the edges of the wound together and uniting with sutures. Dress antiseptically.

DISEASES OF THE GLANS AND PREPUCE.

Balanitis and Balano-Posthitis.—From the urethra to the margin of the prepuce we have a mucous membrane which is drawn comparatively tight over the glans, is quite adherent to the tissues behind the corona, and is then loosely reflected along the prepuce, to which it acts as an inside lining, extending as far as its margin. This is the balano-preputial mucous membrane; and an inflammation of the part covering the glans is called balanitis, while that of the part covering the preputial fold is called posthitis. When the inflammation affects the whole membrane, it is called balano-posthitis. It is most commonly found in persons having a badly fitting prepuce—too long, too tight, with a tight orifice, or a short frænum. The contributing causes are various subpreputial pathological conditions, such as chancres, chancreoids, vegetations, herpes, syphilis, etc.

The exciting causes are carelessness in regard to cleansing the parts, thus allowing an accumulation and decomposition of the sebaceous matter; too frequent coitus with women suffering with uterine troubles complicated with leucorrhœal discharges, pus from urethritis, or ulcerating lesions situated in this locality. Another cause is diabetes, on account of the decomposition of the urine with which the parts are so frequently bathed.

Simple Balanitis.—The surface of the glans presents a bright red or pinkish color, having a soft, moist, spongy appearance, and covered in places with a white, creamy coating. When posthitis occurs as well, and more pressure exists, it has a more mottled appearance, due to the macerated epithelium, which is wanting in places. In this case swelling and redness of the prepuce near the margin take place. Sometimes the balanitis is complicated by a vesicular eruption over the glans, which gives rise to erosions when their rupture takes place. These erosions occasionally develop into ulcerations.

Secondary Balanitis is due to the presence of vegetations, herpes, chancre, or chancreoids, both on account of their irritating discharges and

the interference in circulation caused by their pressure. Ordinarily this condition can be easily detected by drawing back the prepuce, only the phimotic cases are puzzling. In these cases there are very profuse discharge, great redness, swelling, and œdema.

Specific Balanitis is of two kinds: 1. Infecting balano-posthitis. In these cases there is no primary ulceration, but an infiltration of the glans and prepuce, imparting a general feeling of induration on pressure. The inflammation is subacute in character, and the surface varies in color from a pinkish white to a brawny red; erosions are frequently seen, but deep ulcerations are rare. This form of initial lesion comes on so insidiously that frequently the patient does not call upon his physician until constitutional symptoms appear. The character of the lesion and the enlarged glans in the groins and elsewhere are sufficient diagnosis. 2. Secondary syphilis may give rise to macular or papular eruptions of the balano-preputial membrane, and in uncleanly patients not only is the inflammation of the membrane general, but the lesions become excoriated, and may take on a form of superficial or even deep ulceration. The papular efflorescences may become hypertrophied, or may develop into a condylomatous condition—the condylomata lata. In other cases a diffuse induration may take place, resulting in a permanent contraction of the prepuce. These local manifestations may occur either in conjunction with or independent of the secondary eruption on the body.

Chronic Balano-Posthitis is generally found in middle-aged men. It comes on subacutely, with an occasional slight exacerbation. The balano-preputial membrane is stiffened, loses its elasticity, and has a tough, leathery feel. The color of the glans is paler, a bluish white, and is occasionally covered with excoriated patches. It causes a great deal of inconvenience to the patient on account of the constant irritation, and the want of freedom and elasticity in the prepuce during coitus. It is a condition which is accompanied by great epithelial hyperplasia; if not attended to, it may result in a serious complication as epithelioma.

Treatment.—Simple balanitis can generally be cured by washing twice a day with warm water, dusting on a little “A. B. C. powder”—i. e., acid. boracic, bismuth subnit., calomel ãã.—and then placing a thin film of absorbent cotton between the glans and the prepuce. If a lotion is preferred, *lotio plumbi et opii* or *lotio nigra* may be used, every three or four hours. In applying lotions the mistake should not be made of using too bulky wads of cotton. Take a piece of cotton between the fingers, pull it out into a thin film, and spread it over the glans; then pour the lotion over this, when it will flatten to the shape of the parts. If erosions are present, they should be touched with a nitrate-of-silver solution (3 j—3 j). The best method of using silver solution on erosions, ulcers, etc., is by means of an ordinary wooden toothpick, with a thin film

of cotton twisted around the end. The end of this should be moistened with the solution and applied lightly to the lesion.

In cases of secondary balanitis, if the prepuce can be retracted, remove the cause—i. e., vegetations, chancroids, etc.—by applying some mildly astringent powder or lotion to the inflamed membrane. In cases of specific balanitis, acute or chronic, use “A. B. C.” powder; calomel; lotio nigra; sol. bichloride 1–5,000 to 1–2,000; on a film of cotton, having cleaned the parts thoroughly. If erosions are present they should be touched with a silver solution. Give antisiphilitic treatment, and if the patient is cachectic, tonics. In cases of chronic balanoposthitis, circumcision should be resorted to at once. In fact, in all cases of recurring balanitis, which is always due to a badly fitting prepuce, circumcision should be performed.

Diabetic Balano-Posthitis.—This affection occasionally occurs in connection with diabetes. It is a very rare complication, however. Durand Fardel, in speaking of his observations in diabetics, stated that he did not see it once in three hundred and forty-four cases. This trouble begins with the usual symptoms of balano-posthitis—i. e., itching and burning of the glans and prepuce and redness of the mucous membrane covering them, together with a profuse and generally foul pustular discharge. The exuded smegma sticks to the mucous membrane, forming a membranous-like coating. An artificial eczema of the prepuce is now set up, at first subacute in character, accompanied by a redness and thickening of the skin. Little ulcerations appear around its margin as a result of erosions of the mucous membrane and ruptured vesicles. These are at first round, soft, and flat, but later increase in size and assume an irregular form. Fissures and exuberant granulations, very vascular and tender, may also occur. The prepuce becomes still more indurated from the plastic infiltration into its tissues and around the base of the ulcerations, thus causing a condition of phimosis, which is so common in these cases that the disease is often known by the name of diabetic phimosis. In some cases where this condition is not relieved the redness and infiltration become more marked, and a gangrenous dermatitis develops, followed by a slough, more or less extensive, of the prepuce and perhaps some of the adjoining tissues. In the preputial secretion in this disease a vegetable parasite is found, called by Friedreich the *Aspergillus*, consisting, as is usual in this class of parasite, of the mycelium and spores. The spores are round or oval, and usually occur either singly or in pairs. The mycelii are either short and single or long and branched, and sometimes contain spores imbedded in them. They are considered pathognomonic of diabetic balano-posthitis and eczema, and are never found in ordinary smegma. This preputial condition often occurs when there is no other sign of diabetes, and occasionally is the first symptom to point to it. As it has been proved that it may occur

in cases where there is a minimum amount of sugar in the urine, it is always wise, in suspicious cases of balano-posthitis or eczema in this region, to examine carefully the secretion from the parts as well as the urine.

Treatment.—The greatest danger to be feared is that of a split in the prepuce, which may be followed by gangrene, and might prove fatal. Thorough cleanliness, as by irrigations with antiseptic solutions, especially of carbolic and boric acid, after each urination, should be insisted upon, to be followed by a dusting powder of bismuth, borax, and lycopodium, āā. It is also advisable to have the patient urinate through a broken test-tube, so that no urine will touch the tissues. The patient should of course be placed upon an antidiabetic diet. Often the inflammation is so great that antiphlogistic treatment, by keeping the patient quiet in bed with cloths soaked in *lotio plumbi et opii* wrapped about the organ, has to be resorted to for a few days. Occasionally gangrene threatens, and in these cases it is advisable to operate immediately on its first appearance and with the most rigid antiseptic precautions. The object of this operation is to relieve pressure, which can be done either by a dorsal incision or by removing a V-shaped piece from the dorsal aspect of the prepuce. If a slough occurs, the parts should be dressed with charcoal and iodoform āā.

Herpes Progenitalis is a condition characterized by the appearance of one or more vesicles at some point along the balano-preputial membrane, the most frequent locality being the sulcus behind the corona. This is generally an ephemeral condition, and occasionally a recurring one. It may be simple, the vesicles breaking and drying up in a few days, or they may take on an ulcerated form closely resembling chancreoids. Herpes zoster may also occur in this region, as elsewhere.

Simple Herpes appears as one or a cluster of vesicles, surrounded by a little areola. When these break, an eroded surface is left, as that of a cold sore. When these take on an ulcerated form or are situated on the membrane behind the corona, they often have a punched-out appearance, with round or oval clean-cut edges. When they coalesce they do not lose their characteristic outline, but unite in a polycyclic form. They are covered with a little serum, which, when the lesion is near the skin, forms a yellow crust.

Neuralgic Herpes occurs in persons subject to neuralgias. The attack is preceded and accompanied by itching, burning, and painful neuralgic symptoms in the sciatic regions, in the penis, or throughout the whole genito-urinary tract. Painful micturition, and even strangury, are frequent accompaniments. It is evidently closely allied to herpes zoster.

Ulcerating Herpes occurs generally in the cachectic, uncleanly, or in persons who have so tight a prepuce that the lesions are torn whenever it is retracted, thus keeping up a constant irritation. They are very difficult to diagnose from chancreoids.

Recurrent Herpes is often accompanied by balanitis. The lesions are generally situated in the sulcus, and as quickly as one or two are healed others appear; they sometimes continue to recur for weeks. They are generally found associated with a tight prepuce.

Etiology.—Herpes generally occurs in men of a catarrhal diathesis, having a tendency to gout and rheumatism, or in neurotic individuals. The predisposing causes are a tight or badly fitting prepuce, stricture, or some localized inflammatory condition along the genito-urinary tract; also balanitis, urethritis, chancre, and chancreoids. As exciting causes may be mentioned exacerbations of any of the localized inflammations along the genito-urinary tract; excessive venery; contact with acrid secretions, as the menstrual discharge; or irritation, by badly fitting garments.

Diagnosis.—Herpes is often difficult to diagnosticate from chancreoid, chancre, and mucous patches. Herpes differs from chancreoid in the vesicular manner of its appearance; in its grouping; in having less inflammation, less discharge, and a more regular outline; in the history of exposure to contagion; in the lymphatic enlargements, herpes being accompanied by little enlargement of the inguinal glands, even in the ulcerated type, chancreoid being usually accompanied by enlargement, tenderness, and frequently suppurating buboes. Chancreoids are auto-inoculable, herpes usually not. Chancreoids are accompanied by a feeling of soreness, herpes by a sensation of itching or burning.

Herpes very often resembles that variety of chancre which appears as an erosion. The differential diagnosis will be based upon the history, duration, and method of appearance, herpes generally occurring in groups, chancre singly; the base of the chancre being indurated and stiff, that of herpes soft and pliable; outline of edges—the lesions of herpes being often sharply cut, as though punched out, without much elevation of sides, those of chancre usually elevated and indurated; variety of color—herpetic lesions being usually pinkish or light red, those of syphilis dark-red or coppery; the appearance of the surface—that of herpetic erosions being moist and fresh, that of the chancre smooth and glistening. On squeezing the lesions, a serous fluid will exude from a herpetic; from a chancre nothing. The greatest similarity to herpes is shown by the multiple herpetiform chancre. Fournier states that the principal difference is in the contour of their respective margins. In chancre the edges are regularly or irregularly rounded or oval, while in herpes they are polycyclic, simply round vesicles fused together.

Herpetic lesions of the penis are differentiated from mucous patches by the history of the case; by their vesicular appearance; by their form, lesions of herpes usually being acuminate, those of mucous papules flat; by their surface, that of vesicles being covered with serum, that of mucous

patches with macerated epithelium. In the female, when situated on the integument about the vulva, the resemblance is most striking.

Treatment.—Cleanliness, and the use of astringent and soothing powders or lotions, give the best results. If the prepuce is ill-fitting, or the patient is subject to recurrent attacks, circumsise. As a powder, use any bland one—e. g., one consisting of borax, bismuth, and calomel āā. Very often powders keep the parts too dry and accumulate in thick chunks, thus tending to keep up the irritation and to favor the stretching and tearing of the membrane when the prepuce is retracted, and in this way hindering the healing. In such a case a lotion should be substituted. Lotion nigra is exceptionally good in recurrent cases which go on to ulceration, and will often prevent the small vesicles from developing, drying them up almost immediately. When erosions or ulcers develop, they should be touched with a nitrate-of-silver solution every second or third day until cured. If the patient is debilitated, give nerve tonics. Herpes frequently occurs in men who are fat, flabby, soft, and easily overcome by slight exertion; also in the gouty or rheumatic. If due to any trouble along the genito-urinary tract, this should be rectified. If there is much inflammation and pain, as in the neuralgic type, use lotion plumbi et opii.

Verrucæ.—Venereal warts are characterized by hypertrophy of the papillæ of the skin, and an increase in the connective tissue and vascular supply. They are either soft or hard, depending upon their seat. On mucous membranes they are soft, on the integument they are hard. The favorite seat for the moist variety is the balano-preputial membrane, especially the sulcus behind the corona. The hard generally occur on the integument, between the scrotum and thigh. They may be single and pedunculated, at other times sessile, and form cauliflower masses of large size. These sometimes grow to such dimensions subpreputially as to cause not only phimosis, but also ulceration and sloughing of the prepuce. In color they vary from a pinkish white to a deep red. They secrete a pungent, viscid fluid having a disgusting odor.

Etiology.—They generally occur in young adults who are uncleanly, those who are suffering from urethritis, or in those whose parts are unusually moist.

Diagnosis.—Verrucæ acuminatæ can only be confounded with the condylomata lata of syphilis and epithelioma. Verrucæ acuminatæ develop slowly; the condylomata lata appear as flat papules in a syphilitic subject, and later become roughened, moist, and vegetating. Verrucæ differ from epithelioma in that they appear in younger individuals, and are of a much more rapid growth.

Treatment.—There are various methods, such as cauterizing with acetic or nitric acid; curetting and cauterizing the base, or applying

persulphate of iron ; cutting them off with scissors ; tying sutures about the base in pedunculated cases ; the thermocantery, etc. My method of treatment is as follows : Wash the parts thoroughly with hot water, bathe the vegetations with a ten-per-cent solution of cocaine, then paint them superficially with a drachm-to-the-ounce solution of bichloride of mercury in collodion every day or two, and dust on a powder composed of oxide of zinc, tannin, and calomel, *ad*. The bichloride exerts both an astringent and a caustic action ; the collodion, contracting, holds down the already reduced papules ; while the powder tends to keep the parts dry. This application should be made by the surgeon himself, and the patient should be instructed to wash the parts twice a day, and to dust on the powder. He should also be instructed to keep the prepuce drawn over the glans after these applications, otherwise paraphimosis might occur. If the solution is applied carelessly, it will run down between the growths and set up a severe acute inflammation and perhaps a slough.

DISEASES OF THE CORPORA CAVERNOSA.

Acute Inflammations are rare, and generally result from fracture or wounds of the penis while the organ is in a state of turgescence. A phlebitis is set up and a plastic infiltration takes place into the tissue, causing a little pain and tenderness on pressure, with a slight redundancy. This only inconveniences the patient when erection takes place, giving some pain and producing a curvature of that side, the exuded material preventing a complete turgescence of the corpora cavernosa at that point. The inflammation may occur on one or both sides. "In the course of an attack of gonorrhœa the inflammation may extend to the corpora cavernosa and produce an effusion of plastic lymph, which will obliterate the cavities of the bodies and interfere with complete distention in the state of erection of the organ" (Taylor). "The same effect may be produced by small apoplectic deposits in the substance of the corpora cavernosa, the cicatrization of which always entails a deposit of a certain quantity of plastic tissue" (Robert). This likewise causes a curvature toward the affected side, and in exceptional cases, where both sides are affected, erection may take place posteriorly to the trouble, while a portion of the organ in front remains flaccid. Abscess of the corpora cavernosa occasionally but, rarely, occurs.

Treatment.—When the disease of the corpora cavernosa is acute, and pain and swelling are present, some antiphlogistic remedy, as *lotio plumbi et opii*, may be applied locally, and camphor, bromide of potassium, or lupulin given internally to prevent erections until the inflammatory stage has passed over, after which alteratives, iodide of potassium or mercurials, both externally and internally, should be employed. In case of abscess of the corpora cavernosa, poultice and treat as abscess elsewhere.

Chronic Inflammations are more common, especially the variety characterized by the development of thin, fibrous growths or plates. These may occur on one side, on the dorsum, or they may be multiple. They vary in size from a pumpkin-seed to that of a lima bean. They are hard, firm, with a well-defined border, and possess a feeling of elasticity. They are generally sensitive on pressure, and a dull pain may exist. They usually occur in middle-aged men, and most often in those who have had former attacks of urethritis, and cause a curvature toward the affected side. H. V. Miller, of Atlanta, reports a case where two were present on the organ, one on the dorsum about an inch from the pubes, the other on the side about an inch from the glans, causing a double curvature on erection. Johnson reported a case where the fibrous wall of the corpora cavernosa was irregularly indurated, while thickening and consolidation invaded the erectile tissue within. The man complained of lancinating pains in the penis and scrotum. Erections were painful, during which the organ gradually assumed a spiral twist, like a pig's tail or a vermiform appendix. This was on account of the multiplicity of the lesions.

Treatment.—The treatment consists of tincture of iodine externally and iodides internally; later, frictions of hydrarg. externally, with iodides internally. Some favorable results have been reported from the use of ointments which have as a base lanolin or placement, their greater efficacy depending upon the fact that they cause the medicines to penetrate through the tissues much more readily.

Bony and Calcareous Plates may occur in the corpora cavernosa. Dr. William Porter reported a case in the Medical Record some years ago of a man aged sixty-three, who had a small tumor on the right side of the organ attached to the fibrous tissue of the corpora cavernosa. This was cut down on to and shelled out. It proved to be a bony mass or plate six centimetres long by three centimetres wide. It contained lacunæ and canaliculi. These bony growths often develop in the furrow between the two corpora cavernosa, to which they are attached.

In the Museum of Pathological Anatomy in Vienna is a plaster cast of a penis with a bony growth in the dorsum between the corpora cavernosa which bifurcated about the middle of the organ.

Gummata of the Corpora Cavernosa.—Specific lesions are not as frequent in the cavernous bodies as they are in some other parts of the organ, the most frequent seat being the furrow between them. They may be single or multiple. They appear as nodes in the substance of these bodies, and may cause curvatures of the penis. They may remain indolent for a long time, then break down and ulcerate, or, under specific treatment, undergo resolution. The treatment is the same as for gummata elsewhere.

DISEASES AND INJURIES OF THE URETHRA.

By F. TILDEN BROWN, M. D.

I. MALFORMATIONS OF THE URETHRA.

ABSENCE AND COMPLETE OBLITERATION OF THE URETHRA.

THIS deformity is due to union and adhesion of the urethral halves, and their transformation into a fibrous cord.

A certain amount of urine is secreted during intra-uterine life into the bladder. The distended viscus presses upon the umbilical arteries, and seriously interferes with the foetal circulation. Hence these foetuses rarely survive the eighth month of intra-uterine life. Yet Kaufmann has collected seven cases of complete absence of the urethra in which the child lived after birth.

Evacuation of the urine being impossible by the natural passages, one of these things happens: The urachus may reopen and the urine be discharged at the navel; a vesico-rectal perforation may ensue; or the child, surviving until birth, comes into the world with an enormously distended bladder. A number of these latter cases have been operated on with good results.

The *symptoms*, *diagnosis*, and *treatment* are the same as those following complete congenital atresia of the urethra.

CONGENITAL ATRESIA OF THE URETHRA.

This occurs from the fusion of the opposing walls of the urethra. The meatus urinarius or its vicinity is its usual seat. Most often they occur in conjunction with hypospadias, but a certain number of uncomplicated cases are recorded.

Atresia of the Meatus Urinarius.—Here the mucous membrane passes unbroken over the head of the glans, and there is nothing to indicate the site of the meatus. It arises from the same process that causes the "epithelial adhesion" of the mucosæ of the glans and prepuce that is so frequently seen. But few cases of the condition are on record. As a rule, the membrane is very delicate. Voillemier records a case in which it protruded at each effort of the child to urinate, and seemed ready to burst. This explains the apparent anomaly of its infrequent record. The

pent-up urine ruptures it either *in utero* or immediately after birth, and spontaneous cure takes place.

Diagnosis.—Immediately after birth the child draws attention to itself if anything is wrong. Examination of the penis shows absence of a urethral orifice, the penis is enlarged and swollen, the urethra forms a tense cord on the under surface of the organ, and in extreme cases the membrane may project forward on account of the urinary pressure.

Treatment.—An ordinary small sound or probe can be forced through the membrane. If it be tough, an incision will suffice.

Atresia of the Glandular Urethra.—Here the meatus urinarius is usually present, either in apparently normal form or as a furrow lined with mucous membrane, though cases occur in which the glandular urethra is imperforate, together with atresia of the meatus. Most frequently the meatus is well formed, and ends in a *cul-de-sac* at a distance of a few millimetres. The obstruction is more resistant and less evident than in the foregoing variety, and here we meet the more serious consequences of urinary retention, dilatation of bladder and ureters, and hydronephrosis.

The *diagnosis* is made from the absence of urination, the distention of the bladder and the patent portion of the urethra, and the distress of the child.

Treatment consists first in an attempt to reach the urethra by puncture at the meatus, if any indication of it is present; if not, at the apex of the glans. With a fine trocar an attempt is made to reach the distended urethra, and the immediate flow of urine and disappearance of the symptoms show its success. Systematic dilatation with small metal sounds must then be undertaken.

In case the attempt to reach the urethra is not successful, other means must be resorted to. Whitehead punctured the urethra from below, forming an artificial fistula.

Atresia of the Deep Urethra.—This may occur anywhere in the urethral canal; but it is commonest in the pars cavernosa, where it occurs either alone or in conjunction with atresia of the glandular canal. There is frequently also deformity of the rectum, atresiæ or fistulous communications with the bladder. The membranous urethra is less commonly affected, and the prostatic urethra least of all.

Complete retention of urine is the immediate consequence of this condition. The bladder and the ureters are distended, and hydronephrosis occurs. The fœtus usually succumbs at the seventh month, or even earlier, from the pressure of the distended viscera on the vessels, and two thirds of the cases recorded were born dead. The more anterior the occlusion, the greater is the chance of its natural relief by the formation of a urethral perforation or a hypospadias. In some cases the testicles have been

found undescended, the enlarged bladder forming an obstacle to their passage. The same distended viscus has formed an obstacle to delivery, and has had to be punctured before that operation could be effected.

Spontaneous fistula formation has relieved some cases, and at least twice the urachus has become patent from the urinary pressure, and the secretion has been voided from the umbilicus. In a few other cases that have been born alive operative procedure has been successful.

The *diagnosis* rests on the absence of urination, the recognition of the vesical tumor in the abdomen, the distress and vomiting of the child, and, finally, the failure to introduce a catheter.

Prognosis is only fair ; operations have not always succeeded in finding the end of the canal, and a number of these patients have died almost immediately.

Treatment.—Our first resource is catheterization, which may be successful in cases where the occluded segment of urethra is of small extent, an ordinary catheter or buttoned probe being employed. If this does not succeed, a sharp trocar or a bistoury must be used, and the anterior end of the posterior urethral segment found, or an artificial passage made into the bladder. This must be subsequently kept open by the frequent passage of a probe or catheter. Ebert and Rose employed it in their cases.

It would probably be an improvement on the above operation to enter the bulbous or membranous urethra by means of a perineal incision, and then to attempt to reach the glans from behind forward. The free perineal opening would obviate the dangers of infiltration of urine incident to the method of Ebert and Rose, besides giving immediate relief to the retention.

CONGENITAL STRICTURES OF THE URETHRA.

These may occur at the meatus or at any lower point in the urethral canal.

Congenital Stricture of the Meatus Urinarius is usually not revealed until catheterism is attempted. It is frequently accompanied by congenital phimosis. There are cases, however, in which the stenosis is so great that only a fine probe can be introduced, and this naturally interferes greatly with micturition. Kocher operated twice on cases in which he could only introduce No. 9 French. One of these patients was forty-seven years old.

The *symptoms* are usually confined to difficulty of urination ; ischuria, inefficient erection and consequent impotence, and various reflex disturbances, have also been noted.

Treatment.—Repeated catheterism is sometimes effective. Incision is certainly quicker and more direct. It should be done downward, toward

the frænum. A strip of iodoform ganze is placed in the wound, and a short, straight conical sound of full size must be passed every second day. Contraction always occurs to a certain extent, and it is well to cut to several sizes above the one which the meatus is desired to retain. Bleeding is frequently persistent and troublesome, though never dangerous; it may be controlled by introducing into the urethra a section of full-sized rubber bougie and bandaging the penis over it. In some cases it is well to unite the cut edges of the urethral and glandular mucous membrane with sutures.

Congenital Stricture of the Deeper Urethra.—Of this there are a number of recorded cases; but the fact of their having existed from birth is in most cases not susceptible of proof. A stricture may be acquired at any age.

The *symptoms* consist of a history of slow micturition from birth, with a stream that may be as thin as a fine knitting-needle, swellings of the abdomen in the vesical region, attacks of colicky pain due to retention of urine, and examination will show a marked stenosis.

Treatment consists of dilatation with sounds, or internal urethrotomy.

But besides these stenoses of the ordinary kind, valve-shaped strictures occur in various portions of the urethra. Thus, the valve of the fossa navicularis may be abnormally developed, or, rather, the early fœtal septum between the glandular and penile urethra may be abnormally persistent. The partial septum looks forward, and hence is obstructive rather to catheterism than to micturition, the obstacle being met with about three quarters of an inch from the meatus. It is readily seen with the speculum, and sometimes, if the meatus is very large, with the unaided eye.

Valvular folds may, occasionally form strictures in the prostatic urethra. Several are normally present in the region of the ejaculatory ducts, and as their concavity is directed backward, they readily form obstructions to the urinary flow if of larger than average size. Totenatschen has recorded the post-mortem findings in three such cases. The anterior urethra was normal, but that behind the fold was markedly dilated. The bladder was not much dilated, but its wall was greatly thickened from muscular hypertrophy; the ureters were dilated, and hydronephrosis and atrophy of the kidneys were present. Such patients usually die, soon after birth, from renal embarrassment due to the urinary obstacle.

Of the *diagnosis* and *treatment* of stenoses caused by these posterior folds we can say but little. They have not yet been recognized during life. It is well to bear them in mind, however, if in the newborn infant there is retention of urine, and yet catheterization can be effected. Such a condition may then be surmised, and proved later, by the use of a small endoscopic tube of seventeen millimetres circumference. When thus

located they may be severed by a dilating knife passed down the urethral speculum.

CONGENITAL DIVERTICULA OF THE URETHRA OR URINARY POUCHES.

These are very rare malformations. In all the cases recorded they have been situated on the under surface of the penile urethra. They were of large size, especially when distended with urine, and extended from just behind the glans to the peno-serotal fold (Figs. 1 and 2). Hüter operated upon two cases in which the pouch, when distended, was as large as a pigeon's egg; in others it has been much larger, measuring in circumference ten and a half inches, and containing a pound of urine.



FIG. 1.—Urinary pouch, empty.

The walls of these pouches are thin, sometimes remarkably so, and they are clothed with normal mucous membrane. Sometimes the tenuity of the sac is so marked that the connective-tissue bundles, spread apart by the continuous pressure, can be distinctly seen to be continuous with the bundles of the normal urethra behind. In all cases the diverticula occur at the expense of the lower urethral wall; the upper wall is normal, as is also the dermal covering.

As regards the origin of these peculiar malformations but little is known. Anterior obstructions to the urine flow have not always been noticed; in every case catheterization has been easy. A few observers (Hendriksz, Bökei, Hüter) have found valve-shaped backward prolonga-

tions of the glandular segment of the urethra (Fig. 3), which undoubtedly acted as valves when the sac was filled with urine; but in most cases none such were present, and they can not be regarded as the absolute cause of the condition in question. Kaufmann's hypothesis is the most probable.

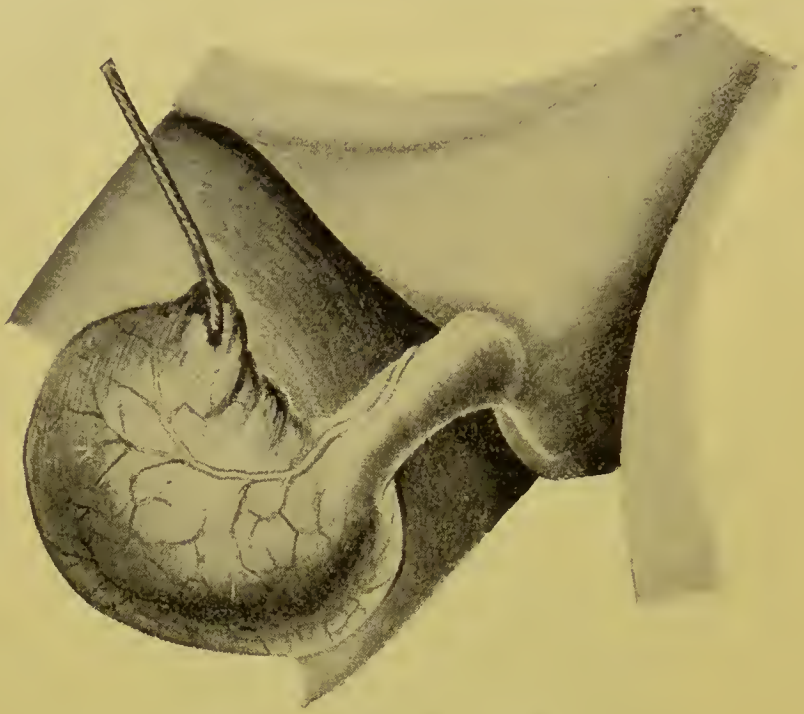


FIG. 2.—Urinary pouch, distended.

He regards it as due to a disturbance of the exact apposition of the glandular and penile portions of the urethral canal at a period of intra-uterine life when urine is already flowing from the bladder. These two portions of the canal, being developed separately, and from opposite directions, any failure as regards the exact time or place of coalescence would cause the urine to accumulate in the anterior blind end of the pos-

terior segment. The lower urethral wall, being the weakest, is naturally the one that gives way, and thus the pouch is formed. When, finally, the growth of the parts or the pressure of the urine does make the canal patent, the distended sac remains with urine in it. Hence it does not tend to disappear, but rather to increase in size.

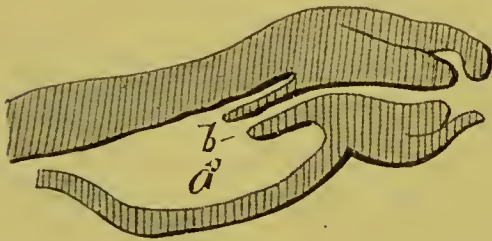


FIG. 3.—Valve-shaped backward prolongations of the glandular segment of the urethra in a case of urethral diverticulum.

The *diagnosis* of these congenital diverticula or dilatations is made from the very apparent alteration in the shape of the penis and the disturbance of urination. The tumor, when collapsed, is soft and fluctu-

ating; when distended, it is tense and resistant; it can be emptied by pressure, it is translucent, and never shows any signs of inflammatory reaction. In about half the cases there has been permanent incontinence of urine; in Langier's case the patient urinated normally, while in those of Hendriksz and Lotzbeck the entire bladder contents flowed into the pouch when the patient passed water, whence it had to be manually expressed. A diverticulum can be readily catheterized, and the instrument can be plainly felt in the empty sac. In only one case is there any note of ammoniacal decomposition of the urine in the sac.

One case only, that of Bökai's, ended fatally; the autopsy showed the usual lesions that result from urinary obstruction, viz., vesical and ureteral dilatation and hypertrophy, cystitis, and purulent nephritis.

Treatment is operative, and has always been successful. The lower wall of the pouch is split on a staff. A long segment is then cut off from each wall of the sac, leaving just enough when united to form a tube of the normal urethral caliber. Valvular folds of the mucons membrane are to be severed when présent. The mucous membrane and skin can then be separately united. Any small fistulous opening that may be left closes readily under cauterization.

The fatal case above mentioned shows that this malformation is liable to cause all the troubles so familiar in cases of obstruction of the urinary passages; hence, all cases should be operated upon.

HYPOSPADIAS.

Hypospadias is that congenital condition in which the urine is not evacuated from the normal point at the extremity of the glans penis, but escapes through an abnormal opening on the lower surface of the penis at a variable distance from the tip of the glans. Our exact knowledge of the condition dates from the memoir of Prof. Bouisson in 1861, and Duplay, Pitha, and Bardeleben have made the condition the subject of exhaustive studies.

Most authorities recognize three distinct varieties or grades of the affection. First, *balanic* or *glandular hypospadias*, in which the urethral opening is either in the glans or immediately behind it. Second, *penile hypospadias*, in which the opening is somewhere on the under surface of the urethra, between the glans and the peno-scrotal fold. Third, *perineal*, in which the scrotum is split, and the urine escapes through an opening between its folds or in the perinæum. Three additional grades include the mixed forms of hypospadias: 1. Glandulopenile. 2. Peno-scrotal. 3. Perineo-scrotal.

Hypospadias is not only the commonest of all urethral malformations, but at the same time one of the most frequent of the entire body. Bouisson says it occurs once in 300 cases of sexual disease. Chaussier found

among 23,293 newborn at the Maternité of Paris, 132 malformations, two of which were hypospadias. This is entirely too low a proportion. The French military surgeon Rennes found ten hypospadiases in 3,000 recruits—a proportion of one in 300 males. The statistics vary much, but of its frequency there can be no doubt.

Etiology.—The causes of hypospadias are obscure. Certain observations would tend to show its heredity, and the existence of some influence that determines its appearance in several members of one family. Bryant records three cases in which both father and son were affected. The older theory, that it is due to a rupture of the urethra, has been questioned, and it is more generally regarded as referable to an arrest of development. The urethra is primarily a groove, open below, which grows forward out of the sinus urogenitalis in conjunction with the corpora cavernosa; it gradually closes from behind forward. Incomplete closure to any varying degree of this primitive urinary groove would therefore cause hypospadias; in hypospadias perinealis, the urethra's entire length; in hypospadias penis, its anterior half; and in hypospadias glandis, its anterior extremity, remaining incompletely formed.

But this simple developmental theory by no means explains all the cases that we meet. Hypospadiases show the greatest possible varieties of form, and are very difficult to classify, which would hardly be the case were their origin so simple. The glandular portion of the urethra is not developed in the manner the theory supposes, and cases of balanic hypospadias, the commonest of all, conjoined as it often is with imperforate meatus, can not be so accounted for. Then there are cases in which the urethra is apparently normally developed, and there are one or more congenital urinary fistulæ on its under surface, perhaps with distinctly cicatricial tissue in their calloused edges. In fact, most cases do show special changes in and about the misplaced meatus. This orifice is smaller than natural; the skin around it is smooth and shining, pigmented and cicatricial. Besides which there are often bends and twists of the penis, adhesions of that organ to the scrotum, anomalies of the prepuce, asymmetry of the raphé and the frænum. Some better explanation is evidently necessary.

In certain cases there can be no doubt of the fact that rupture of the urethra occurs during foetal life. Wiener has shown us that the secretion of urine is active during foetal life; the bladder is repeatedly filled and emptied. If there is any fault in the proper fusion of the glandular and penile portions of the urethra, the urine will tend to force its way through the proximal urethral walls. Some hypospadias orifices are so manifestly cicatricial that there can be no doubt at all of their originating in this manner.

Upon this fact, and upon his own observations of cases and museum

specimens, Kaufmann has based his theory of the formation of the meatus which seems to fit all cases, including normal and abnormal ones. His idea is that cases of hypospadias arise when there is a mechanical obstruction to the functional activity of the urethra after the urinary secretion has been established in the foetus, with consequent retention and final rupture of the urethra. This rupture occurs oftenest, of course, in the direction of least resistance, which is the septum between the external invagination which forms the glandular segment of the urethra and the deeper canal. But if that section is absent, or if it is backward in its development, the urine forces an opening somewhere else.

Thus the glandular urethra may be entirely absent, or it may be present in whole or in part, and end in a blind sac. In some cases the two urethral segments have almost come together; a thin valve-like partition, perhaps perforated, being all that remains, yet at the time that the first urine accumulations occurred the obstruction must have been much more resistant, since the hypospadiac perforation has occurred in preference to the normal one.

The point of rupture of the penile urethra is oftenest situated at its extreme anterior end, just posterior to the glans. The under surface of the prepuce is invariably absent, and usually also the lower half of the glandular urethra which is thus represented by a groove. This is probably caused in the same way as is the urethral opening; the urine infiltrates the periurethral tissues and forces its way out.

Hypospadias of the penile portion of the urethra admits of a similar explanation. The same obstruction between the glandular and penile urethra has been present, but for mechanical reasons perforation has not been effected through the anterior end of the penile segment. Hence ensues dilatation of the urethra, with rupture of the tube, infiltration of urine, and a destruction of tissue varying in extent and locality in different cases. The urethral pouches, which we considered above, help to bear out this theory of the mechanical origin of hypospadias. The two conditions are intimately related, it being only the final establishment of the communication between the two urethral segments that prevents the rupture of the pouch and the formation of a penile hypospadias. Congenital urethral pouches are rare, because in most cases of obstruction rupture does occur and hypospadias results.

The cicatricial tissue frequently found associated with hypospadias and the various cicatricial contractions are also best accounted for by Kaufmann's hypothesis; as are torsion and flexion of the penis, adhesions to the scrotum, and fissures of the same. Even in the lightest degree of glandular hypospadias the glans is often drawn down at an angle with the shaft of the penis; in higher grades the entire organ is usually flexed; and the extensive loss of skin and subcutaneous tissue with

cicatricial contraction sufficiently accounts for it. When the urethral dilatation is great, the scrotal skin is necessarily implicated, the urinary infiltration is greater, and the loss of substance and contraction is proportionate. Adhesion of the penis to the scrotum is unknown save in cases of hypospadias, and is to be explained by the same infiltration and cicatricial contraction. In this way also occurs the defective penile development observed in the worst cases of perineal hypospadias.

Balanic or Glandular Hypospadias (Fig. 4) is that form in which the opening of the urethra is situated on the under surface of the glans, in the place of the absent frænum. The prepuce is deformed in

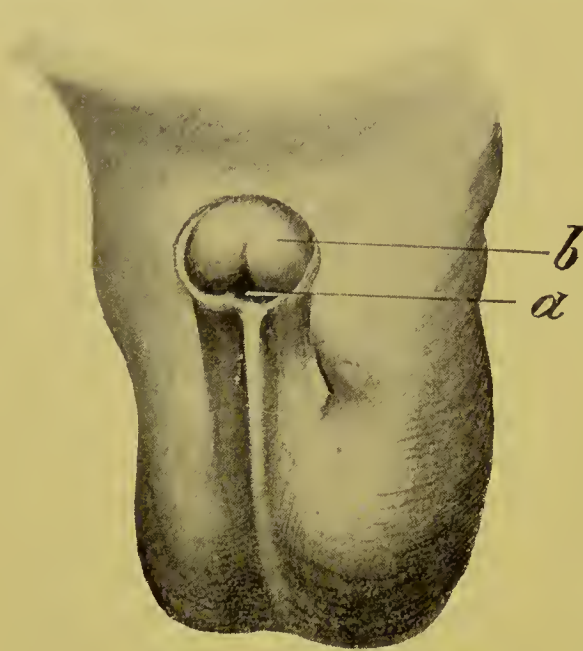


FIG. 4.—Glandular or balanic hypospadias.

every case. On the dorsum of the glans it is well developed, and forms a thick fold that projects beyond its anterior extremity; thence its two lateral folds run backward and downward, getting thinner until they become continuous with the margins of the urethral opening. The meatus is usually at the spot where under normal circumstances the anterior extremity of the frænum is attached to the glans penis, or it may be situated a little farther back in the retro-glandular sulcus. In the newborn it is often merely a punctiform opening,

which can be recognized only during micturition; in older children it will admit a fine probe. It always remains, however, extremely small. The skin and mucous membrane at the orifice is frequently distinctly cicatricial. The opening is usually single; but two, and even three, openings have been observed, the supernumerary ones either communicating with the primary orifice, or ending in blind sacs.

The details of form vary much in different cases. Thus, the glans may be imperforate and the glandular urethra be entirely absent (illustration, F. A. v. Ammon, *Die angeborene Chirurgisch. Krankh. d. Menschens*, Berlin, 1842, Table xviii); or there may be a more or less perfect meatus in the usual situation, ending in a blind sac of varying length (Forster, *Atlas*, Fig. vii).

In most cases of balanic hypospadias a deep furrow extends from the normal position of the meatus to the urinary opening. Its lateral walls are continuous with the remains of the prepuce. The remains of

the foetal septum between the glandular and penile urethra are sometimes persistent as a crescentic fold; it being the same structure occasionally observed under normal conditions, and known as the valve of the fossa navicularis.

A change in shape of the penis is observed in nearly all adult cases of balanic hypospadias. This change generally consists in a downward deflection of the glans from the direct penile axis. The amount of deflection, which varies in the different cases, is usually small; but it may be marked, and in the worst cases the glans may even point backward, the urethral orifice being situated in the angle between the base of the glans and the apex of the penis itself. Union of the penis with the scrotum is also

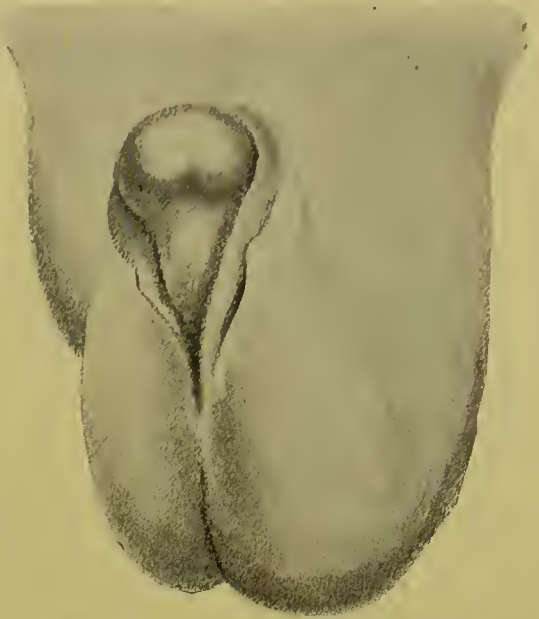


FIG. 5.—Glandulo-penile hypospadias.

sometimes seen. Two distinct forms of this deformity have been observed. In the lesser form a thin membrane unites the raphés of penis and scrotum together, interfering moderately with erection. In the other variety the skin covering the penis is continuous on both sides directly with the scrotal integument; the glans is the only free portion of the organ, and the urinary opening lies completely concealed in the angle formed by scrotum and glans.

Torsion of the penis is present in a certain number of cases of balanic hypospadias. In Verneuil's case the dorsal surface of the penis looked toward the scrotum, and its urethral surface was turned forward and to the left. The urethra itself had been correspondingly twisted from right to left and from before backward; it was twisted spirally around the left corpus cavernosum. Finally, a livid condition of the glans, the scrotum, or the prepuce—or of all of them—may coexist with glandular hypospadias. These organs then have more or less resemblance to the vulva, and form one of the species of false hermaphroditism.

Penile Hypospadias.—Here the urinary opening is situated somewhere between the base of the glans and the peno-scrotal fold. It is usually small, and may be covered with a fold of skin; its shape is oval, with its large diameter in the axis of the penis. Its edges are sharp, smooth, and shining; sometimes they are distinctly calloused and cicatricial. As a canal, the urethra in front of the hypospadiac opening is almost always absent, but a deep groove is frequently present, provided with more

or less elevated erectile margins. Sometimes a hard ridge alone marks the course of the normal urethra to the apex of the glans. It is usually six to eight millimetres broad in the adult.

Certain concomitant abnormalities are frequent and important. Thus, the scrotum may be distinctly divided into two halves by a deep median furrow apparently cicatricial, which runs from the urethral opening to the lower border of the scrotum. The scrotum, otherwise well developed, ascends as a thick, wrinkled mass on each side of the penis, and is continuous with the skin covering its upper surface. The deep scrotal furrow permits the under surface of the arch of the pubes to be distinctly felt, with the urethra winding under it. The corpora cavernosa are so separated that no bulb of the urethra is apparent, the introduced catheter seems to lie quite subcutaneously in the perinæum, and the prostate shows a marked thinning at its center.

The mucous membrane of the deeper urethra is continued directly forward on the floor of this groove. The openings of Littre's glands are usually dilated. Marked narrowings and even partial obliterations of the anterior visible urethral groove have been recorded by various observers. Sabatier (Voillemier, *Maladies de l'urèthre*, Paris, 1868, page 551) records a unique case, in which every indication of the anterior urethra was absent.

On the other hand, in some cases the urinary canal is fairly perfect anterior to the opening, though the meatus in these cases is usually imperforate. Arnaud, Lacroix, and Lippert have recorded cases of this kind.

The penis in these cases is almost invariably smaller and shorter than normal, both in children and adults, the cavernous tissue being deficient. The penis is curved downward—a deformity which is especially noticeable during erection, which causes the penis to be pulled down and backward. Retraction of the corpora cavernosa, as well as what remains of the urethra, is an efficient cause of it.

Torsion of the penis has been observed, of which De St. Germain gives a remarkable example (*Chirurgie orthopédique*, page 428).

Perineal Hypospadias (Fig. 6) is the rarest of all kinds of this malformation. The deformity is greater and more complicated than in the other two varieties. The scrotum is completely divided, and the urinary opening is situated in the depths of this furrow—some three or four centimetres in front of the anus. It is generally in the shape of a little slit, elongated vertically, and edged by two mucocutaneous folds, which unite behind and suggest the introitus of a small vagina.

The urethral segment anterior to the urinary opening shows the same variety of conditions as in penile hypospadias. Most often it is present as a more or less shallow groove running along the scrotal cleft and the under surface of the penis. Sometimes it is represented merely by a

fibrous cord occupying the same position. In a case recorded by Mares-tin, the urethra was perfect anterior to the hypospadiac opening, but the meatus was closed by a membrane. Or, again, the meatus may be normal, but it ends in a blind sac; the segment intervening between the posterior end of the sac and the abnormal urinary opening being represented by a groove or fibrous cord, as above described.

The penis itself is usually atrophied, and is more or less firmly applied to the scrotal fissure, concealing the urinary opening. The organ is shorter than normal, especially on its inferior surface, though the glans is often well developed. It is strongly incurvated, due, according to Bouisson, not to tension of the muco-cutaneous urethral ridge or furrow, that extends from the hypospadiac opening to the glans, but to arrest of development of the corpora cavernosa, even the septum of which is sometimes found strongly contracted.

Marked cases of perineal hypospadias, where the cleft between the lateral halves of the scrotum, lined with a pale, rosy mucous membrane, was deep, and the atrophy and retraction of the penis were great, have caused considerable difficulty in the determination of sex. Particularly was this the case when the testicles were atrophic or undescended.

Symptoms.—These consist in the first place, of course, of the changes appreciable to the examining eye and touch. They are sufficiently evident from the detailed description given above. But there are other symptoms referable to derangements of function that demand attention. They occur in connection with micturition, copulation, and fecundation.

Disturbances of urination are common. In glandular hypospadias the function is normal, and even in penile hypospadias it can be well accomplished if the patient lifts up the penis so as to completely uncover the opening. But in perineal hypospadias the abnormal position of the urinary opening causes much trouble. The membranous and prostatic portions of the urethra being well developed, the urine is projected with force; but the stream, breaking against the incurvated penis, is scattered in all directions; so that patients affected with perineal hypospadias are compelled to urinate in the sitting position, like women, or they soil their garments. Other urinary troubles are present in some cases. Persistent urinous odor and eczema are annoying complications.

In balanic and penile hypospadias copulation is not much interfered

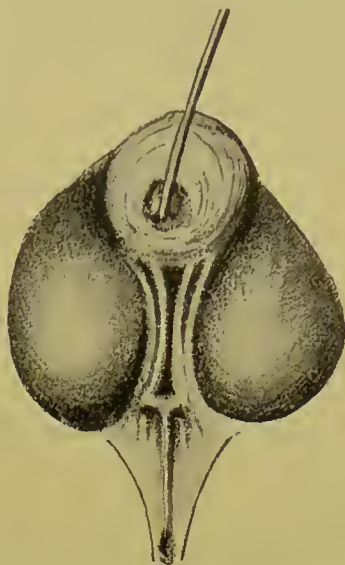


FIG. 6.—Perineal hypospadias.

with, though fecundation may be entirely abrogated; this will certainly be the case if the urinary opening is situated so far back as to lie outside the vagina during copulation. In hypospadias perinæi the *facultas coeundi* is usually absent. The abnormal downward curve of the penis, and its adhesion to the scrotum, causes the glans to be carried during erection backward and downward into the fissure of the scrotum.

Diagnosis.—Save in the newborn, the diagnosis of hypospadias is easy. Mere inspection suffices. The act of urination will ordinarily confirm the diagnosis. In infants just born, however, the hypospadiac opening may be so very small that it is overlooked. Ranchfuss has reported a case in which the atresia of the meatus led to a diagnosis of urinary obstruction, leading to the formation of an artificial urethral canal with the trocar, subsequent examination, however, showed that a hypospadias was present. Percussion of the bladder should enable us to avoid such mistakes. Traumatic splitting of the penis may be confounded with a hypospadias. Chopart recounts a case in which an individual split his urethra gradually from meatus to scrotum; and a traumatic fistula may simulate a hypospadias.

The determination of sex in infants affected with perineal hypospadias is sometimes difficult, especially if the testicles have not descended. The two scrotal halves may look very like the labia, and the small and adherent penis like an abnormally large clitoris. Abdominal palpation, combined with rectal and vesical exploration and sounding, will, however, in all cases reveal the absence of the uterus, while the presence of the prostate gland will determine the diagnosis.

Prognosis varies with the severity of the case and condition and age of the patient. Surgical procedures will restore to almost all these individuals both external symmetry and satisfactory genital and urinary functions.

Treatment.—To relieve the urinary retention that is dependent on the narrowness of the abnormal orifice is usually easy. In children it often suffices to dilate the opening with fine sounds. In older individuals this is not enough. Bökai recommends the circular ablation of the skin around the borders of the opening, the median splitting of the mucous membrane, and the uniting of the cut edges of the skin and mucous membrane by sutures. Kaufmann recommends the splitting of the urethral mucous membrane longitudinally, and the insertion of a small triangular flap of the external skin between its edges.

Bouisson was the first to practically treat the hypospadias itself as a deformity. He showed the necessity of a preliminary straightening of the incurvation of the penis before attempting to make a new canal; for this incurvation obstructs the passage of urine and semen, and interferes more or less completely with coitus. That being done, the forma-

tion of a new urethral canal may be attempted with hope of better success.

If the hypospadias assumes the shape of a congenital urinary fistula immediately behind the glans, freshening of the edges, and an exact suturing, usually suffices. Any abnormally developed valve of the fossa navicularis must be ablated at its base. If there is membranous closure of the external meatus, it must be incised. If the balanic urethra is normal, but ends in a blind sac, the missing urethral segment must be reproduced by Duplay's method (*Archives générales de médecine*, Mai et Juin, 1874), and then united to the glandular and penile urethral segments.

If the glans is entirely imperforate, a new canal must be made with the trocar, means being then employed to keep it patent. Dieffenbach has given the following instructions for this operation: "The penis being put on the stretch and drawn as far away as possible from the body, the trocar is pushed through the glans along the under portion of the organ from its apex to the anterior end of the penile urethra. The cannula is allowed to remain in place after the trocar is withdrawn, being later exchanged for a sound, until the canal has cicatrized." Nevertheless the tendency of the new canal to close is very marked.

Gouley's process is similar, but in addition he takes out a wedge-shaped transverse section from the dorsum of the penis, so that the resulting cicatrix shall tend to straighten the organ.

Duplay's method for hypospadias is the most complete. He divides the entire process into three successive stages:

1. Straightening the penis, and formation of a glandular meatus (Figs. 7 and 8).

2. Formation of a new urethral canal from the extremity of the glans to the neighborhood of the hypospadiac opening (Fig. 9).

3. Junction of the two portions of the canal.

1. *First Stage* (Fig. 7).

—This may be omitted in those cases in which the penile incurvation is very slight. A free transverse incision or incisions must be made into the middle of

the ridge which unites the glans to the hypospadiac opening, as deeply as may be necessary to secure straightening. The fibrous sheath may have

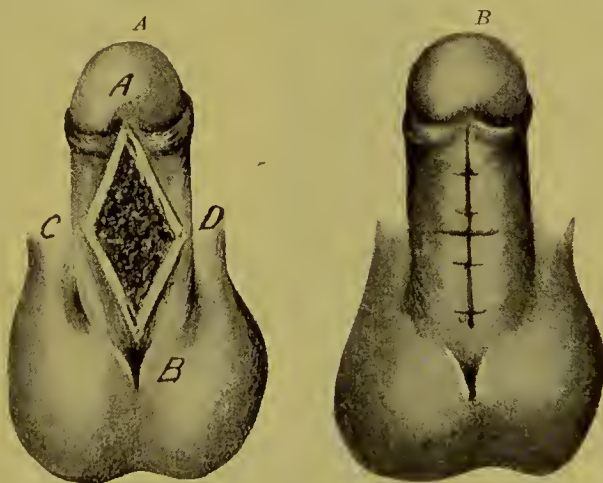


FIG. 7.—Duplay's operation for hypospadias.
Straightening of penis.

to be divided, and even the corpora-cavernosa deeply incised; both may be done with impunity. During cicatrization the penis should be kept extended by means of adhesive plaster, or, better, by lateral splints and dorsal sutures.

It is well to delay the second stage of the operation until it is certain that incurvation will not recur. After six or eight months this will be assured.

2. *Second Stage* (Fig. 8).—Duplay insists upon the necessity of the new canal being as much as possible surrounded by erectile tissue, especially in its glandular portion. The meatus must be situated in the glans. If the semen escapes from a flaccid canal below it, ejaculation will be imperfect, and the chances of fecundation must be limited.

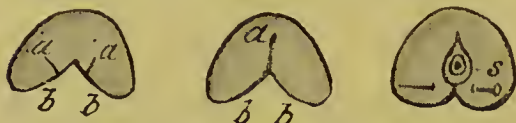


FIG. 8.—Duplay's operation for hypospadias. Formation of glandular meatus.

The edges of the glandular furrow are to be freshened, and if it is deep enough they may be united over a sound or staff. If it is not deep enough, a single median longitudinal or two lateral and parallel incisions are to be made, the sound is laid in them, and the canal is enclosed by suture over it. Primary union is almost always obtained. Some opera-

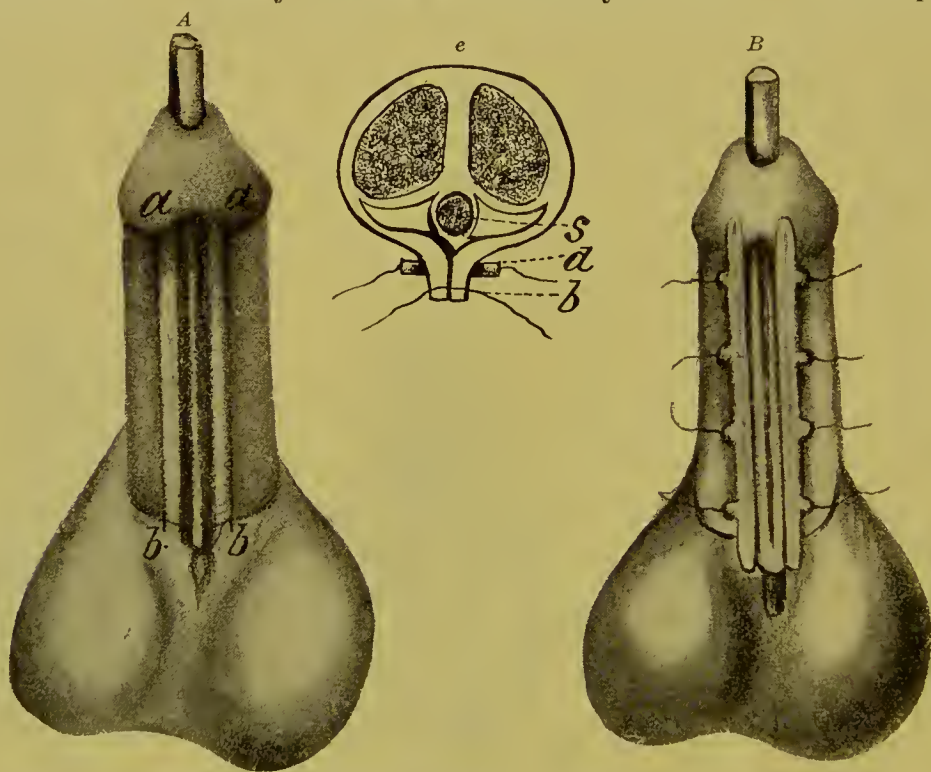


FIG. 9.—Duplay's operation for hypospadias. Formation of new urethral canal.

tors prefer to combine this first part of the second stage with the straightening operation, and time may undoubtedly be gained by so doing.

To form the new penile canal the following method is employed : The penis is held up, and on each side of the median line is made a longitudinal incision reaching from the base of the glans to within a quarter of an inch of the hypospadiac opening. These incisions are parallel one with the other, and not less than a quarter of an inch apart. The internal lip of each incision is then to be slightly dissected up. Each external lip must now be freely dissected, so as to be able to draw to the median line the skin of the lateral parts of the penis. Then the cutaneous surface of the inner flaps is turned toward the cavity of the canal ; the raw surfaces are turned outward, and are covered by the raw surfaces of the external flaps. The canal thus formed is only half cutaneous, but this suffices to prevent cicatricial contraction.

Now the displaced flaps are to be united in the median line by modified quilled suture (Fig. 9). A fine single silver wire is to be used, in order to avoid the tracts and large openings of the ordinary wire, the sutures being about a quarter of an inch apart. The ends of each wire are passed through holes made in small leaden tubes ; then these lateral tubes are evenly approximated and there fastened with perforated shot. A few points of interrupted superficial suture may be employed to complete the canal externally. Contact is exact, and erection can be resisted.

Third Stage.—Another interval of time is necessary, to be sure that the new canal shows no tendency to contraction, and then we can proceed to join the two portions of the urethra by obliterating the hypospadiac fistula. The circumference of the opening must be freely vivified for half an inch all round, and a catheter having been introduced by the new canal into the bladder, the same quilled single-wire suture as described above is to be employed to close the defect that remains.

As regards the management of the urine, Duplay recommends the employment of a retained catheter left constantly open, so that the urine may escape as fast as secreted. After two or three days the patient is allowed to urinate without assistance, being placed in the knee-elbow position to facilitate the process.

As regards the age at which the operations are best undertaken, the first stage should be done early—at the fourth year—and the second in the next year or so, so that the relatively normal penis may participate in the development natural to the period. The last stage should be postponed until puberty, since a certain amount of intelligence on the patient's part will greatly help the surgeon. Nevertheless it may be done in a shorter time. Lücke has cured a case, aged nineteen years, in one year, and Duplay one twenty-one years old in eighteen months.

EPISPADIAS.

Epispadias is a malformation characterized by a more or less extensive division of the upper wall of the urethra, through which the urine escapes. Congenital vesical fissures, often found combined with epispadias, belong to the section on deformities of the bladder, and will not be considered here.

Various degrees of the deformity are met with. In glandular epispadias the urinary opening is situated just behind the glans penis; in penile epispadias it is situated more posteriorly, on the dorsum of the organ or just in front of the symphysis.

Epispadias is of extremely rare occurrence compared with hypospadias. The commonest form of epispadias is that of the deeper urethra in conjunction with ectopia of the bladder; less common is epispadias of the penis, and least common of all is epispadias of the glans. Exactly the reverse of hypospadias in relation to position.

Glandular Epispadias (Fig. 10).—The rarity of this malformation is shown by the fact that but three cases of its existence are recorded. The first was observed by Adelman and drawn by Von Ammon (F. A. J. von Ammon, *Die angeborene Chir. Krankh. d. Menschen*, Berlin, 1842,

Tab. xviii, p. 85). The second and third are those of Marchal de Calvi and Dollinger, of which complete descriptions are given by Kaufmann (*loc. cit.*, page 40). These cases show us two distinct forms of penile epispadias. In the rarer form the entire body of the glans is divided into two halves, only united at their lower margins by the floor of the urethra. More commonly the glans is entirely solid, being furrowed upon its upper surface by a urethral trough but a few lines deep.

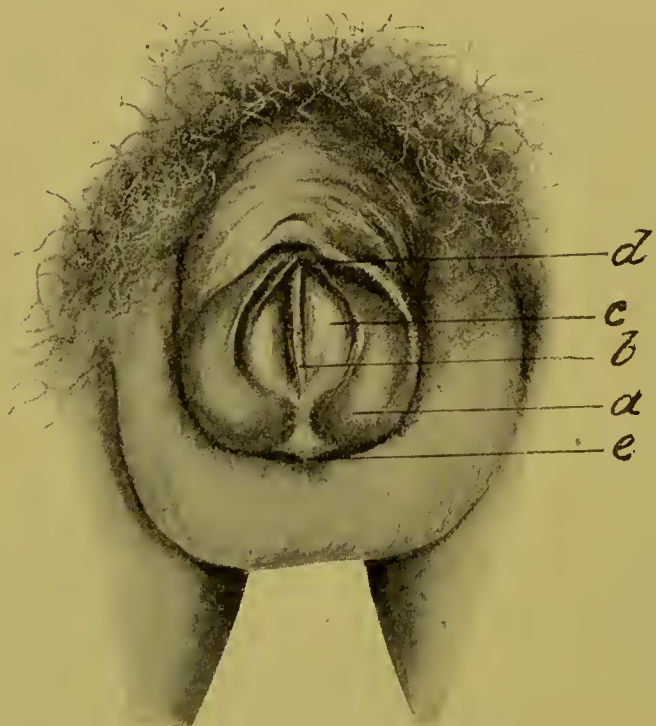


FIG. 10.—Rare glandular epispadias.

The other changes in glandular epispadias are not very marked. The penis is somewhat shorter, and, as it were, more voluminous and spread out than normally. It is fairly well formed

externally. It is worthy of note that the prepuce never seems to be involved.

Epispadias of the Penis (Fig. 11).—Here the urinary opening is on the dorsum of the penis, and most commonly immediately in front of the symphysis. Only a single case, that of Foucher's (Fig. 11), is partial in the sense of the French authors, the opening being situated on the middle of the dorsum penis, and all the other relations being normal; it is the spongo-glandular epispadias of Duplay (Fig. 11). In the usual type (Fig. 12) the massive prepuce hangs as a triangular fold upon the normal scrotum. The frænum is well developed, and is attached to the lower and anterior surface of the glans, which lies in front of the pubis. The upper surface of the glans is in contact with the protruding abdominal skin, which is continuous laterally with the scrotum, there being apparently a depression in the abdominal skin for the reception of the glans.



FIG. 11.—Spongo-glandular epispadias. Rare form of penile epispadias.

When the glans is dragged downward and forward the true relation of the parts is seen (Fig. 12). The penis is rudimentary, being one to two inches long. It is curved upward, and almost always twisted. Its upper surface is occupied by a broad and not very deep groove, beginning at the glans and running to the root of the penis. This groove may extend to the apex of the glans, or may end half an inch behind it. In some cases no urethral furrow has been present at all. Both in penis and glans the urinary furrow is lined with mucous membrane, and the pin-sized openings of the mucons follicles are very apparent in it. The edges of the urinary furrow are usually rounded, and the mucous membrane merges gradually into the surrounding skin. In the cases of Larrey and Guyon, the urinary furrow was a deep and narrow cleft, with a bridge over it just behind the glans.

Just in front of the symphysis the urethral groove ends in a deep, funnel-shaped opening, covered in part by a fold of the abdominal wall. Above this fold is the aforementioned depression in which the glans

penis rests; it is lined with a mucous-membranelike reddish, shining tissue. Palpation reveals the fact that the symphysis is absent, the hori-



FIG. 12.—Penile epispadias. Commonest form.

zontal rami of the pubes are half an inch to an inch apart, and between their ends lies the depression for the glans.

The segment of normal urethra that remains is usually very patent, so that in some cases the index-finger could be readily carried into the bladder.

As regards the rest of the genito-urinary organs, we have but few data. In the records of the four autopsies that

have been collected the bladder and the ureters were found unchanged. The prostate gland has been found absent by Breschet and by Thiersch. Diastasis of the pubis has been found in about half the cases. The corpora cavernosa were well developed in their posterior portions, but of the corpus spongiosum only a piece an inch in size was present, and the bulb was smaller than normal. No erectile tissue was found at all in the anterior portion of the penis. In fact, the relations of the erectile tissues have varied much in the different cases.

Etiology.—Much that has been said in regard to the etiology of hypospadias holds good here. In fact, it is epispadias that gives the chief support to the etiological theory advanced for both conditions—viz., that both are due to a rupture of the urethra in consequence of urinary retention by the absence or retarded formation of the glandular urethra.

The usual theory of epispadias is similar to that which explains hypospadias as due to incomplete or faulty development of the parts affected. Thus, Thiersch regarded the malformation as due to a pelvic closure and division of the cloaca, which was faulty as regards time. Under normal circumstances pelvic closure occurs first, so that the corpora cavernosa developing in connection with the rami of the pubes are already agglutinated to the sexual buds before the sinus urogenitalis is pushed forward

by the developing perinæum. But if the cloacal division occurs before pelvic closure the two halves of the corpora cavernosa are not united; the urogenital sinus is pushed forward between them, and they unite below instead of above it.

This hypothesis evidently depends for its premise upon the absence of the symphysis, and, unfortunately for it, the symphysis is not always absent.

On the other hand, a number of facts undoubtedly favor the rupture hypothesis, and are quite inexplicable on any theory of defective development. Absence or imperviousness of the urethra leads to accumulation of urine in the bladder and dilatation of that organ; a rupture occurs at a time when the abdominal envelopes are not yet quite perfect; and this rupture may affect the entire urinary sac from the navel down, or only its lower part. So we get epispadias with exstrophy of the bladder, or simple epispadias. Thus, Thiersch has proved, both in the dead and the living subject, that the ureters are much dilated in all these cases, he even succeeding in passing a No. 6 English catheter through the ureters into the pelvis of the kidney. Scar tissue also is found all around the bladder opening "as from an unsuccessful plastic operation"—distinct evidences of rupture and cicatrization.

But the most incontestable proof of the correctness of this so-called mechanical theory of the origin of epispadias is found in the cases of intra-uterine healing of exstrophy of the bladder and of epispadias, of which the best case is that of Küster. Here, in a boy one year and seven months old, an unmistakable scar stretched from the umbilicus on to the dorsum of the penis.

In fact, it may well be that the separation of the pubic rami is the direct effect of the same urinary retention that causes rupture of the vesical and urethral walls. Thus, an early rupture of the urethra would give us a simple epispadias with normal symphysis. Whereas, if this early rupture does not occur, the symphysis separates; if the urethra now ruptures, we get simple epispadias with absence of symphysis. If both bladder and urethra rupture, we get exstrophy of the bladder and epispadias.

What, then, are the causes of this urinary retention, and what are the factors that decide whether it shall rupture on its lower or upper surface; whether hypospadias or epispadias shall result, the glandular segment of the urethra being imperfect or absent? In the great majority of cases, as we have seen, this occurs on the lower border. It is not possible for us to say precisely why in a few cases it selects the upper surface. Evidently the place of least resistance will give way. It may be that the formation of the glans is abnormal and belated; it is possible that the position of the fœtus may be such, or the cord may be so located, as to

put abnormal pressure on the lower surface of the penis to prevent hypospadias and induce an epispadias.

Such a dorsal perforation is by no means so simple a matter as the ventral one; the urine has to force its way, first upward at the posterior border of the glans, then upward and forward through the glans itself. The furrow on the upper surface of the glans is not the divided urethra; it is due to the perforation. If the glandular urethra is present at all (which is rarely the case), it is much deeper, as Dollinger's case shows.

The non-union of the symphysis is explained by the condition of the bladder. Thiersch is of opinion that the mere presence of a distended bladder will prevent union of the rami. In any case the amount of force is not great. The shortening of the penis depends on the deformity of the symphysis and the division of the corpora cavernosa, as well as from the cicatricial contraction that follows the rupture of the urethra and the infiltration and breaking down of the surrounding tissues.

Epispadias probably occurs at the time of the first accumulation of urine in the bladder, as does hypospadias. The adherents of the developmental theory fixed its occurrence at the fourth to the sixth week, when the pelvic girdle is formed and the cloaca divides. It probably occurs much later, though its precise date can not be fixed.

Symptoms.—These include the results of examination, which are fully given above, and certain functional disturbances of varying degree. When epispadias is incomplete, these latter symptoms are not marked. The most important of these is incontinence of urine. It was not present in the three cases of glandular epispadias that have been recorded, as well as in a number of cases of complete deformity. The stream, however, is imperfect even in those patients who can hold their urine; it is divided and scattering, soils the clothing, wets the neighboring parts, and leads to excoriations, etc. But in most cases there is permanent incontinence, and, this added to urinous odor, constitutes the most serious symptom of the deformity. Some of these individuals can retain their urine for a considerable period of time when lying down, but change of position, coughing, or anything that increases the abdominal pressure, will cause it to exude. The explanation of the incontinence is somewhat obscure, but since the bladder itself is normal there must be some defect of the closing apparatus. Where the symphysis and prostate are absent its occurrence is readily understood. In other cases Trendelenburg has shown it to be due to abnormal width of the urethra, so that the sphincter can not work completely. The incontinence got better when the urethra was narrowed.

The sexual function of the penis is fair, in spite of its misshapeness. Erection and ejaculation occur, but copulation is imperfect and fecundation impossible.

The separation of the pubic bones is readily recognized by palpation. It is a source of great annoyance to the patient, since it enlarges the epispadic opening and still further interferes with the sphincter. Exstrophy of the bladder occurs with epispadias, but it is a distinct malformation, and will be considered elsewhere.

Prognosis is favorable. The incontinence usually improves after a closed urethral canal has been formed, so that the patient can hold his water for from one to two hours. If incontinence remains after operation, this can usually be controlled by wearing an apparatus to close the new urethra.

Treatment.—The operations for the relief of epispadias are among the triumphs of modern surgery, not only relieving the deformity, but

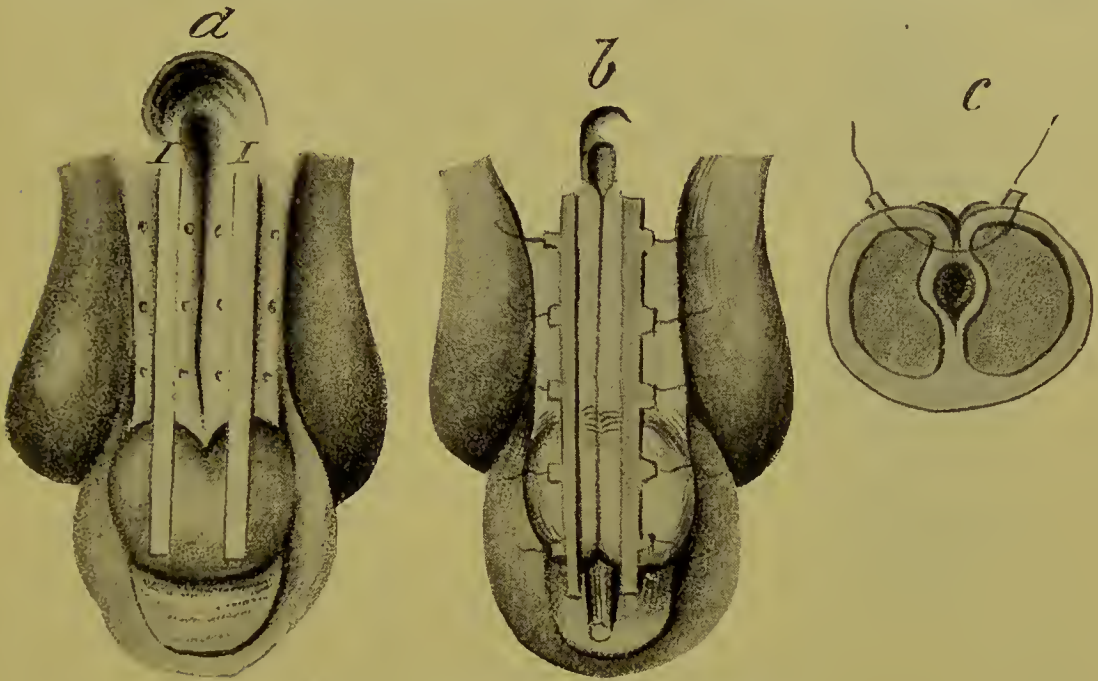


FIG. 13.—Duplay's operation for epispadias.

restoring an almost perfect symmetry to the parts. Two methods have been most successful:

1. Median union of the edges of the urinary groove (operation of Dieffenbach and Duplay).

2. Plastic closure of the urinary canal by the formation of flaps (method of Nélaton, Dolbeau, and Thiersch).

I. Duplay divides his operation into three stages:

1. Straightening of the penis.

2. Formation of a new canal from the extremity of the glans to the neighborhood of the epispadic opening.

3. Junction of the two portions of the canal.

1. It is often difficult to straighten out the penis, owing to defective

development of the corpora cavernosa. Single or multiple incisions are made into those bodies in the neighborhood of the pubes. The process is the same as that used by Duplay for hypospadias, but done on the dorsum of the penis. Subsequent development of the penis helps the straightening.

2. An attempt is now made to form a new canal almost exclusively from the corpora cavernosa and the corpora spongiosum. The septum of the corpora cavernosa in epispadias is fibrous and thin; by depressing it from above downward the corpora cavernosa are approximated, and a groove is formed in which the sound may be laid. It can be deepened by incision if too shallow.

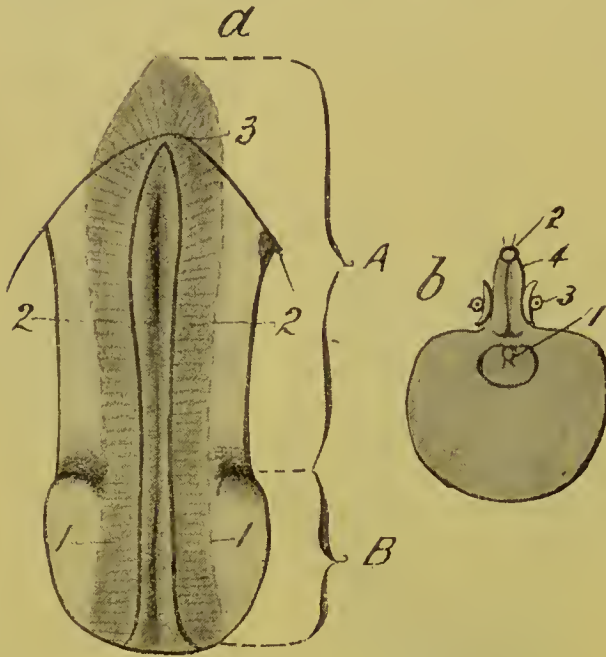


FIG. 14.—Krönlein's operation for epispadias.

Then a strip on each side of the penis about a quarter of an inch in breadth is vivified, running from the extremity of the glans to the neighborhood of the epispadic opening (Fig. 13, *a*). Apposition is secured by the same single-wire quilled suture as was used in the hypospadiac operation (Fig. 13, *b*). A permanent catheter is now passed into the epispadic opening, to draw off the urine as fast as secreted, and prevent its bathing the wounded surfaces.

In most epispadiases the prepuce is very large, and forms, especially in its lower portion, a cutaneous mass which is disfiguring, and may hinder coitus. This exuberant prepuce is to be transplanted to the dorsal surface of the penis. The upper surfaces of the corpora cavernosa are suitably vivified; a large button-hole is made in the thickness of the prepuce at the base of the glans, into which the head of the penis is passed; the two folds of the prepuce, having been dissected free, are applied to the dorsal surface of the organ. This fulfills two important indications: it removes the redundant prepuce, and the thin, rosy, mucosa-like skin of the dorsum of the penis is replaced by normal integument.

3. The epispadic opening is now a fistula, furrowing deeply under the pubis. Its edges are to be freely vivified and then approximated by shotted suture. More than one operation for this purpose may be necessary.

Krönlein modifies Duplay's operation by employing two instead of three stages (Fig. 14).

Plastic operations for the relief of epispadias date from Nélaton, in 1852; his operation was afterward modified by Dolbeau. It consisted essentially in building up a new canal by means of flaps taken from the abdominal wall and serotum. But Nélaton's autoplasty did not alter the faulty shape of the penis, nor was the urinary control sufficient. The process invented by Thiersch has entirely displaced it. Thiersch's operation for epispadias is divided into five stages:

1. *Making a Preparatory Perineo-vesical Fistula*.—The left index-finger or a male catheter having been introduced into the bladder, the bladder neck is pushed toward the perineal raphé as much as possible, and an incision made through the raphé in front of the anus. An elastic or metallic tube is put in, and a fistula is produced. Thus the urine is entirely diverted from the subsequent field of operation.

2. *Change of the Glandular Furrow into a Tube, with its Mouth at the Apex of the Glans* (Fig. 15).—On each side of and parallel to the glandular furrow an incision is made. The two cuts converge at an acute

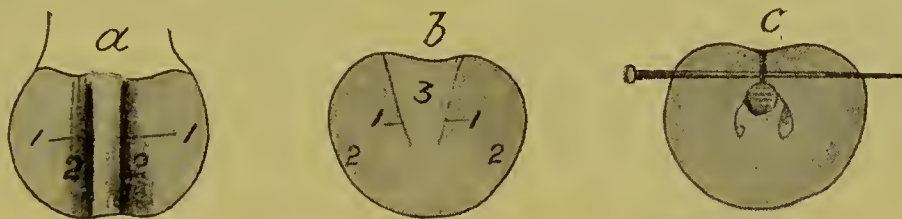


FIG. 15.—Thiersch's operation for epispadias. Second stage.

angle, and should go two thirds through the thickness of the glans, dividing that organ into two lateral flaps and a middle wedge-shaped piece. A narrow strip upon each side of the incisions is now vivified, and the two lateral flaps are pulled together over the central depressed segment. The vivified surfaces are united by two or three stitches, and the new canal gets its epithelial covering from the central sunken wedge (Fig. 15).

3. *Transformation of the Penile Furrow into a Tube* (Fig. 16).—Two thick, long, and rectangular flaps are cut on the dorsum of the penis on each side of the urinary furrow. Both look the same way, the attached margin of the right one being along the right border of the dorsum of the penis, while the attached margin of the left one runs parallel and near to the left margin of the urinary groove. This last flap is now turned over, so that its epidermal surface faces the groove, and its raw surface is external. It is temporarily fixed in this position by three or four sutures, to the free ends of each of which a separate needle is attached. The right flap is then drawn over the left one, so that the two raw surfaces coincide, and the entire denuded tissue is covered. Before, however, the lips of

the right flap are fixed in their new position, both ends of the sutures put in the left flap must be passed out through the base of the right flap and

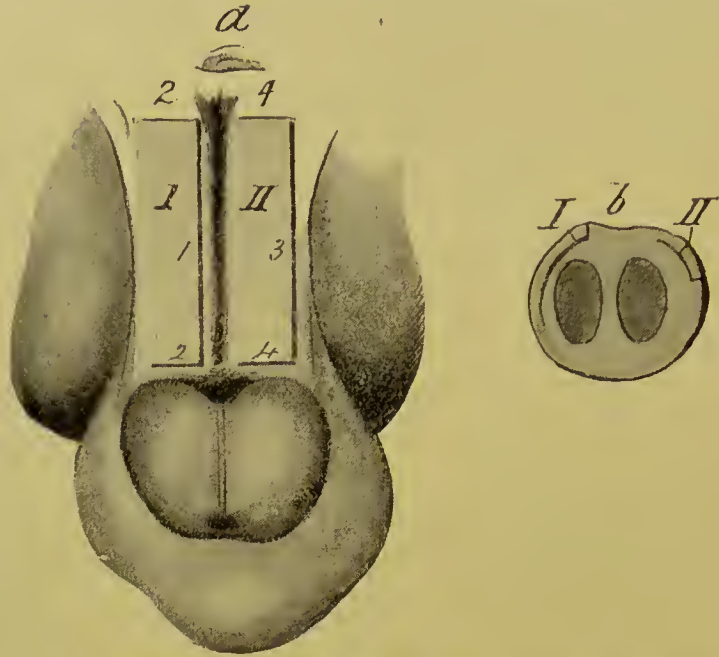


FIG. 16.—Thiersch's operation for epispadias. Third stage begun.

tied; then the left margin of the covering flap must be fixed by sutures. In this way we obtain a tube completely clothed with epidermis, and the entire surface is covered with skin (Fig. 17). Care must be taken that

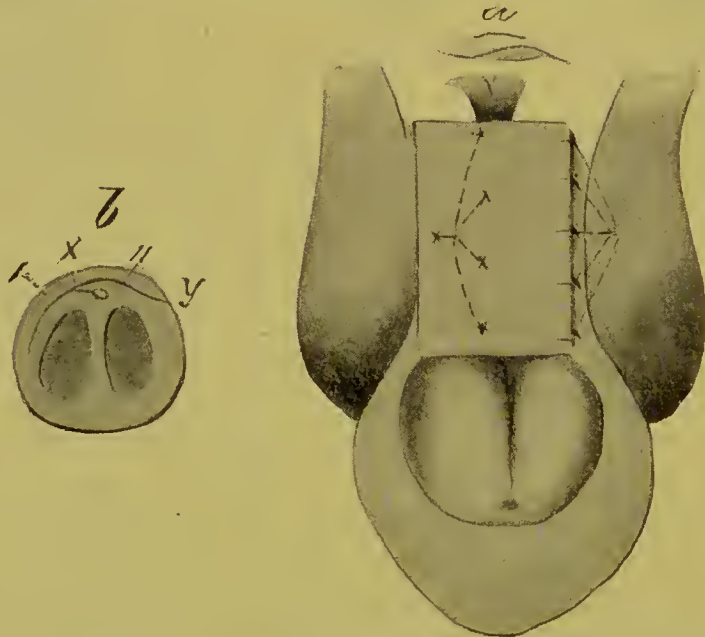


FIG. 17.—Thiersch's operation for epispadias. Third stage completed.

the flaps are as thin as possible, and they must be very freely loosened from their bases, to prevent all possible tension.

4. *Uniting of the Glandular and Penile Portions of the New Urethra* (Fig. 18).—The opening between the two segments is to be closed by the anterior half of the prepuce. A hole is cut through its entire thickness large enough to admit the glans, which is thrust through it. The cleft between the glandular and the penile urethra is freshened, and the two leaves of the prepuce, being somewhat separated, are sutured to it and to the vivified lower border of the glans.

5. *Closure of the Funnel* (Fig. 19).—Two flaps are cut from the abdominal skin above and to one side of the orifice. The first flap at the left side has the form of a right-angled triangle, whose base covers half of the upper margin of the opening. It is so turned down

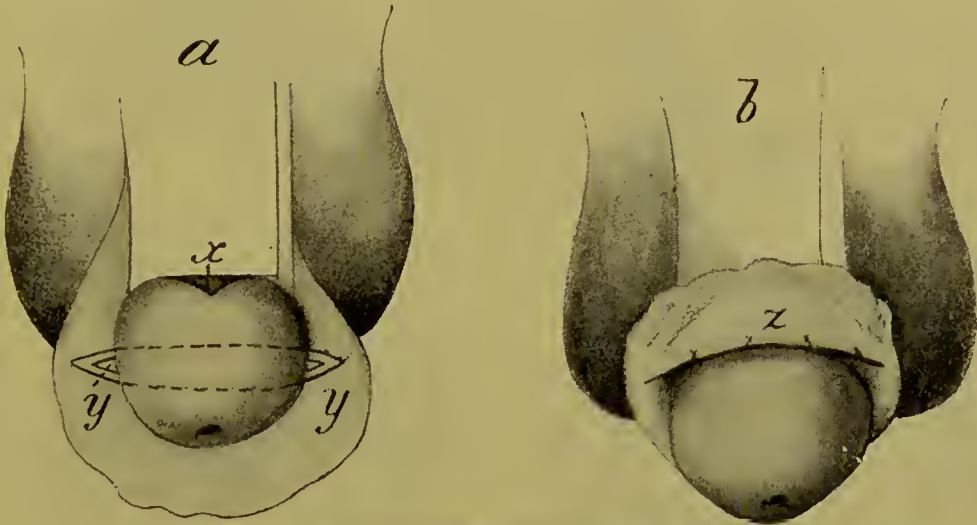


FIG. 18.—Thiersch's operation for epispadias. Fourth stage.

(Fig. 19 A) that the dermal surface looks into the funnel, and its free margin is then united to the vivified edge of the new covering of the penis. The second flap forms a long quadrilateral (Fig. 19 B), with its base in the region of the right inguinal canal. Then it is pulled down until the raw surfaces of both flaps coincide, and are fixed with sutures. The denuded places in the abdominal skin are allowed to heal by granulation.

The perineal fistula heals of itself—and the treatment is ended.

Thiersch calculates that the perineal fistula takes fourteen days to be established; the closure of the glandular groove, fourteen days; the closing of the penile groove, twenty-one days; the transplantation of the foreskin, fourteen days; the closure of the funnel and subsequent operations, forty-two days—altogether about four months.

The results are excellent in every respect, and Billroth characterizes the operation as one of the most brilliant in the entire range of plastic surgery.

There occur cases, however, in which the skin of the penis is not sufficient to form a new urethra. For these cases Lossen has modified Thiersch's operation. He proceeds as above described until he comes to the formation of the second dorsal flap, for which purpose he takes integument from the right side of the scrotum. Then a prepuce is formed, after Thiersch. A left scrotal flap has to be taken to close the urinary funnel.

As regards our selection of operative procedure, it will depend upon the case. Median union of the urinary furrow is simplest and best where it will suffice, as it sometimes will in cases where there is but little penile

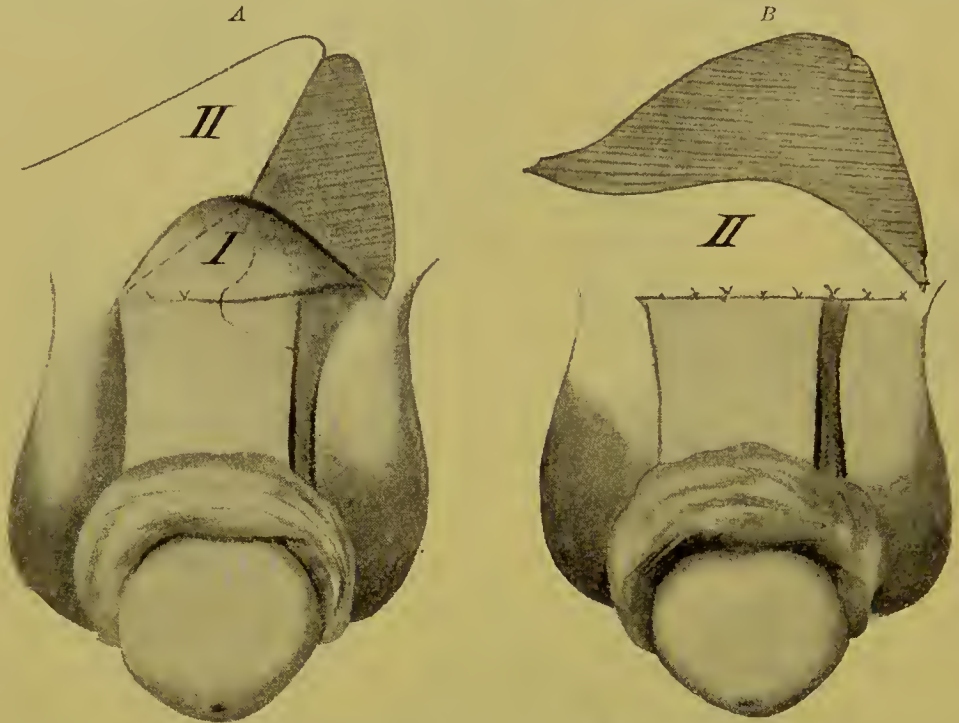


FIG. 19.—Thiersch's operation for epispadias. Fifth stage.

deformity. For other cases we can choose between the methods of Diefenbach, Duplay, and of Thiersch. Nevertheless, the latter will undoubtedly become the chief method, both on account of its certain and brilliant results and its almost universal applicability.

In Thiersch's operation a triple row of stitches and a double covering protect the new canal; so that when, as frequently occurs, some of the superficial stitches tear out, the parts are still kept in position. The avoidance of a permanent catheter is also of great importance; its presence frequently spoils the most carefully executed plastic operation.

II. URETHRAL AND PERI-URETHRAL ABSCESS.

Collections of pus occur in the peri-urethral connective tissue, and may grow to a considerable size. Perforation of the urethra from any cause permits the urine to escape from the canal, whence it slowly makes its way into the surrounding tissues. Here it acts as an intense irritant, provoking inflammation, suppuration, and even gangrene of the invaded tissues. From such causes we meet with abscess in an acute and chronic form. The microbial infections of these punctured wounds, whether by the penetrating body, or by entrance into the wound, from its urethral side, of any of the pathogenic micro-organisms which are known to be normally present in this canal are to be thought of as more direct causative agents than the urine, which in the latter cases can only, as the possible carrier, be looked upon as the indirect cause. Urine free from micro-organisms, ptomaines, and leucomaines is inadequate for abscess formation.

Acute Urinary Abscess.—A stricture of the urethra leading to rupture is the common precedent of this condition. The course of the pus and the resulting damage vary in accordance with the location of the urethral lesion. If the rupture is in front of the triangular ligament, as is most often the case, the pus collects in the anterior perineal region, spreading to the sides of the anus and scrotum, even reaching the under surface of the penis, which may be half buried in the infiltrated mass, and is tender and resistant to the touch. If, on the other hand, the rupture is in the membranous urethra, behind the triangular ligament, the pus collects in the prostatic fossa. Its forward advance is hindered by the triangular ligament, and it makes its way into the ischio-rectal fossa, and points near the anus. The course and complications of these deep urethral abscesses are very similar to abscess of the prostate and abscess of the seminal vesicles, which are described elsewhere. -

Only in rare cases does such an abscess break into the urethra, pus flowing from the meatus in the intervals of micturition and appearing in larger quantities when the tumor is squeezed. Spontaneous cure then occurs, the tumor diminishing gradually in size, and the small indurated lump left behind gradually disappearing. Almost always the abscess opens externally; pus and urine infiltrate the cellular tissue, and troublesome fistulae and grave disorders result.

Symptoms.—Slight chills, irregular fever, tension in the perinaeum, and difficulty of micturition are the indefinite symptoms that mark the advent of pus in the cellular peri-urethral tissue anterior to the triangular ligament. The pulse is rapid and irritable, the skin parched, the tongue dry. In the anterior perineal region is found a rounded, hard, painless

tumor, extending perhaps so far as to encroach on the scrotal and anal districts. If the abscess is behind the triangular ligament, the general symptoms are the same; but no distinct tumor is appreciable in the anterior perinæum; only the skin covering the ischio-rectal region is indurated and brawny, and rectal examination will often reveal fluctuation, especially unmistakable if it has spread posteriorly—that is, over the sacrum and coccyx.

Diagnosis.—If a patient who is the subject of stricture presents general symptoms—of sudden advent—as described above, a careful examination of the perinæum should at once be made. The local symptoms may not be pronounced enough to attract the patient's attention; or he may state that the induration or tumor has been present for weeks, and can not be the cause of his trouble. A perineal abscess, not communicating with the urethra, may be mistaken for a urinary abscess; or, conversely, an apparently simple perineal abscess may, a few days after opening, show by the flowing of urine from the wound that it originated in the urethra. Luckily, the treatment is the same in both cases.

Treatment.—The first step is the free incision of the tumor, practiced even before fluctuation is perceived. The pus is very deep-seated; sometimes two or more inches of tissue must be divided before it is reached. If not given an external vent early, the pus, being limited by the perineal fasciæ, will pass backward, and cause mischief around the neck of the bladder and in the cellular tissue of the pelvis.

Many authorities are satisfied to open the perineal abscess, leaving the stricture to be treated later by dilatation or otherwise; but Bryant regards this as temporizing, and advises the division of the stricture at the same time. A grooved staff is passed through the urethra down to the abscess, if it can not be passed into the bladder; the tissues are then freely divided through the perinæum. If the orifice of the vesical end of the urethra can be detected, a large catheter should be passed and left in. In any case the stricture has been divided, the pus is freely evacuated, danger of extravasation of urine is prevented, and a free passage for the kidney excretion is provided.

Chronic Urinary Abscess.—Urine infiltrated into the peri-urethral connective tissue is so irritating that it almost always causes an acute abscess; chronic urinary abscesses are rare. They occur in the pendulous urethra as well as in the perinæum. In the perinæum they occur as small, rounded, hard tumors, adherent to the urethra, and covered with normal skin. In the pendulous urethra they may be multiple, and form little hard nodules adherent to the urethra. Both perineal and penile chronic abscesses may at any moment become acute; or they may long remain quiescent, and even ultimately undergo absorption and obliteration.

Symptoms are hardly present. They are often so painless as to

escape the notice of the patient. Examination then alone reveals their presence.

Diagnosis is ordinarily free from difficulty. However, a peri-urethral abscess may be mistaken for a urinary abscess, and *vice versa*; but since the treatment in both cases is the same the mistake is not serious.

Treatment.—Tincture of iodine may be applied externally over the chronic perincal urinary abscesses; it is not always advisable to open them. The penile ones can also be left alone, save when annoying; in that case they may be evacuated, and the resulting fistula treated *secundum artem*. Where the urethra will permit of the introduction of the wire speculum, it has recently been my practice to expose by it the urethral opening of these small blind abscesses, when by external pressure the contents, even if very trifling, can be seen to exude into the urethra. Now with a fine blunt bent silver tip (Fig. 24, B) a few drops of hydrogen peroxide are forced by syringe into the cavity. On evacuating this again by pressure a minim or two of five-per-cent argentum nitrate solution is introduced. Fine as is this syringe-tip, it is not always easy to introduce it into the very minute fistulous opening in the urethra. A fine, probe-pointed bent knife may then be used to open the abscess more freely on the urethral surface, after which cleansing as described is easily done. By this procedure all danger of urethral fistula is avoided.

III. URETHRAL ULCER AND EROSION.

Ulceration, more commonly erosion, of the urethra occurs as a complication of specific urethritis. It is generally a sequela rather than an accompaniment of the acute stage of gonorrhœa. Whether the gonococcus by deeper invasion than usual, or a mixed infection, or personal neglect, is most often responsible for the occurrence of these lesions, has not yet been determined. Rough and septic foreign bodies introduced into the urethra, the continued contact of urethral calculi, herpes of the urethra, may all serve as causative agents. Urethral chancroid, although presenting much the same anatomical appearances, and amenable, but more slowly, to the same treatment, has, I believe, a distinct etiology. I purposely omit consideration of the slight inflammatory erosion often existing at some one point on the proximal side of a stricture.

The most common locality for all these lesions is within two and a half inches of the meatus. I have found them more commonly on the upper rather than the lower segment of the urethra. With the urethral wire speculum (Fig. 20) they are readily seen and treated. They vary from a pin-head to a pencil-head in size; they may be single or multiple. The appearance of these lesions is different, when viewed at the extrem-

ity of a cylindrical Klotz tube, from their appearance as seen through the lateral bars of the wire speculum. This difference is due to the mechanical pressure of the speculum; and by reason of it the true hyperæmia

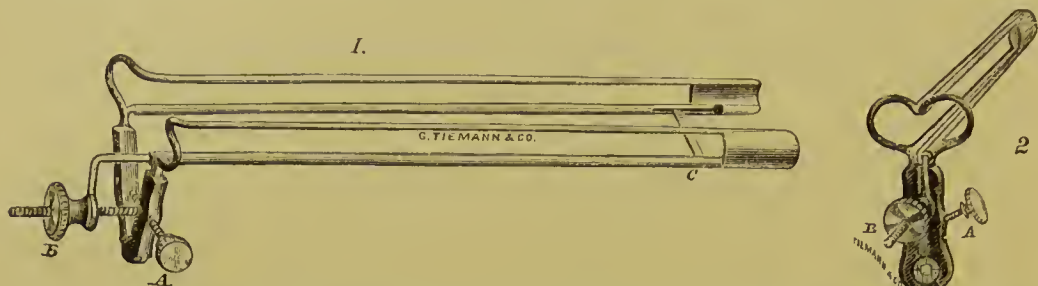


FIG. 20 (1).—The author's wire urethral speculum, open. *C*, the lever for spreading the vesical end, which is governed by the right-angled rod attached to the traveling screw-button, *B*; *A*, the screw which spreads the base or meatus part of the speculum. (2.) The author's wire urethral speculum, closed.

of the area surrounding the ulcer or erosion is less striking, but a much greater field is shown, and the details of the individual lesions are better exposed for observation and treatment.

Erosion of the urethra shows an absence of the smooth, pinkish-yellow, normal mucous membrane, and a faint cellular infiltration about its margin, attended by increase of color. When such a lesion is exposed to sight and its surface touched with a blunt instrument, the extreme sensitiveness of the lesion becomes manifest.

Ulcer of the urethra shows a complete loss of the mucosa; its edges are precipitous or in part overhanging, so that a right-angled probe, or the urethral digit (Fig. 21), will be perceptibly caught as it is drawn



FIG. 21.—The author's straight six-inch urethral digit. *C*, the movable probe-tip controlled by U-spring and thumb-screw at handle. Inch-marks are indicated along the upper rod.

across the lesion. The edges are clean cut or slightly irregular, considerably infiltrated, and consequently elevated not alone above the floor of the ulcer but higher than the surrounding mucous membrane. The floor of the ulcer is covered with a greyish-white mucopurulent secretion, which on being removed shows an uneven granulating or pitting surface. A secondary inflammatory areola often surrounds the hyperæmic borders of the ulcer. The most positive subjective symptom of urethral erosion, or ulcer particularly, is a sense of pricking pain in the urethra, wholly independent of the act of miction. Urination may elicit the same discomfort momentarily, but it is the sudden striking sensation which is felt in the intervals which will prompt us to look successfully for such a cause. Occasionally quite remote reflex pains are experienced in the

groin and down the leg. At times these lesions cause functional disturbances of the bladder and muscles of the deep urethra, akin to the reflexes not infrequently excited by anterior strictures of large caliber.

In some cases an appreciable enlargement of the inguinal glands will be noticed.

A trifling but positive mucopurulent secretion from these lesions will, if looked for, be found in each glass of urine passed.

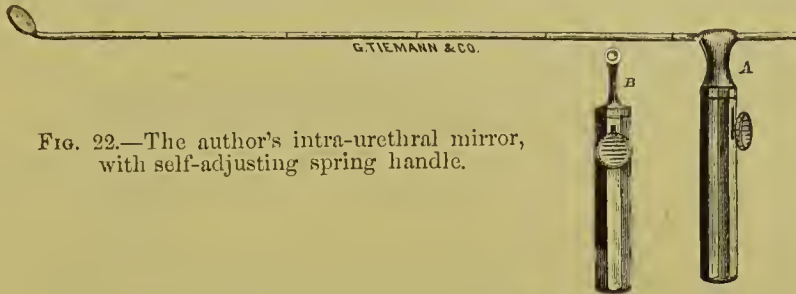


FIG. 22.—The author's intra-urethral mirror, with self-adjusting spring handle.

When a bulbous instrument, without giving distinct evidence of stricture at some one point, does at this particular point cause a good deal of sharp pain, an erosion or ulcer of recent formation may be suspected.

The urethral digit will help to verify the diagnosis, but it is only

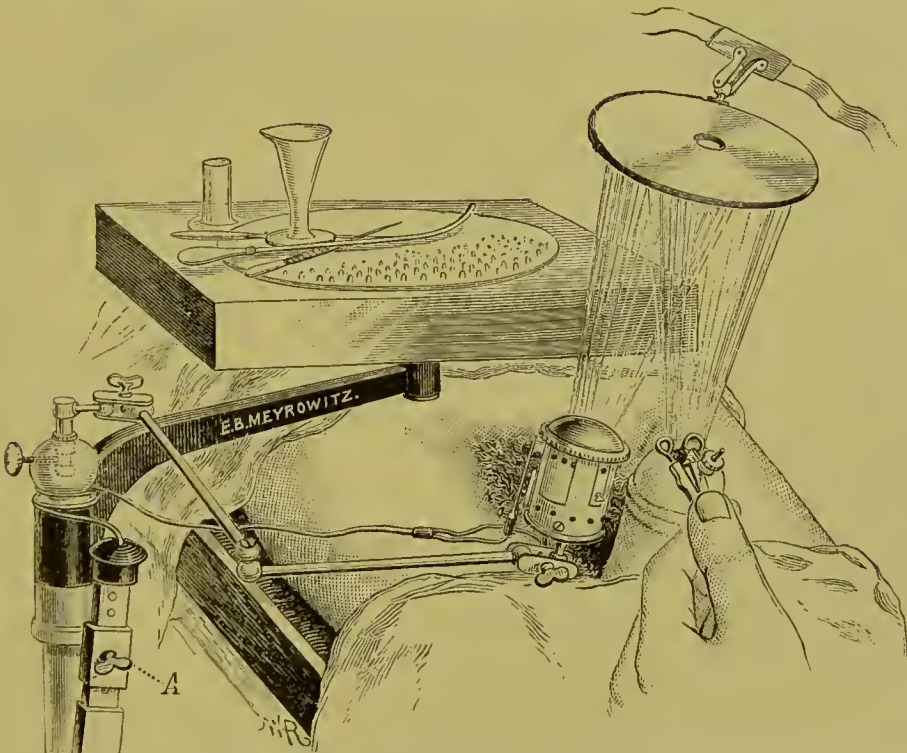


FIG. 23.—The author's method of urethral illumination by electric-light condenser parallel with penis. Head mirror is shown reflecting the light through the speculum into urethra.

by the use of instruments (Fig. 23) which afford an ocular demonstration of the lesions that the disease can be positively diagnosed.

The intra-urethral mirror (Fig. 22), illuminated by reflected light from the head mirror, will very clearly reveal the details of these lesions as they are exposed by the speculum; but the mere presence of an ulcer with its truncated cone summit and its inflamed borders can be readily determined without the aid of the intra-urethral mirror, particularly if it is not deeper than two inches.

Treatment.—Only by resorting to the use of instruments which will expose these lesions to the eye can the treatment, as well as the diagnosis, be made satisfactory. To effect this, I prefer my wire speculum, already mentioned.

If the patient is nervous, or if the parts are particularly sensitive, a preliminary injection of fifteen to thirty minims of four-per-cent cocaine solution will be of aid. The speculum is introduced closed (Fig. 20, 2), and gradually opened at both ends until a favorable exposure of the ulcer is obtained. Now the floor and walls of the ulcer are to be cleansed with a drop or two of hydrogen peroxide, best applied by a syringe with a long, delicate silver tip (Fig. 24), so bent where it comes off the syringe that hand and syringe do not interfere with the line of vision. The part

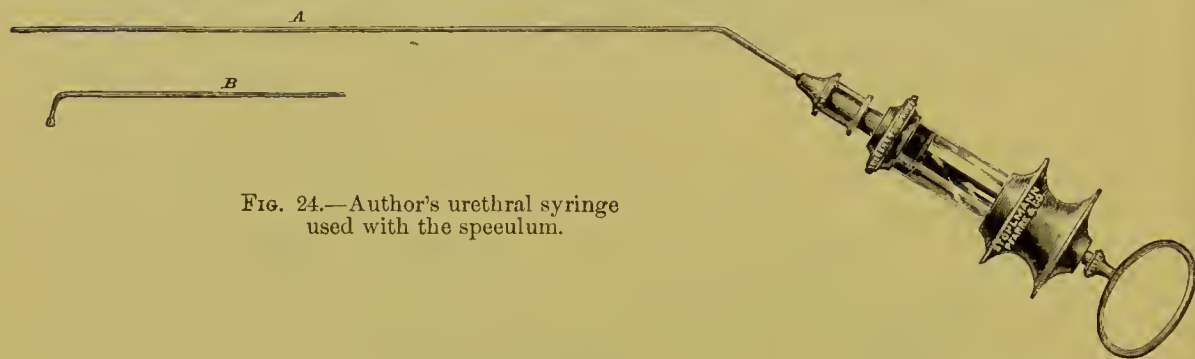


FIG. 24.—Author's urethral syringe used with the speculum.

is then wiped with a small cotton swab. Finally, an application of silver nitrate solution, one half to ten per cent strength, is made by a similar syringe-tip wrapped with cotton. The dilatation of the urethra effected by the speculum during such application every fourth or sixth day is an important adjunct to the treatment in promoting absorption of the inflammatory infiltration, thereby lessening the amount of cicatricial contraction which normally attends the healing process.

- If such an ulcer of the urethra has existed for several months and has escaped treatment, its appearance will differ from that of the acute ulcer already described, and the treatment must be different. It will now show as an indurated ulcer, the inflammatory process being almost limited to the areola at a little distance from the infiltrated whitish edges and walls of the ulcer, while its base will be affected to a lesser degree by this same whitish infiltration. Tension upon this immediate area of the urethra by the dilating arms of the wire speculum will reveal a marked impair-

ment of the normal elasticity and the patency of the mucous membrane, consequently an examination by bulbous instruments would now certainly detect a slight but appreciable loss of normal caliber.

At this stage of the ulcer topical applications are of no practical value, for the indolent character of the nutrition processes calls for more energetic treatment.

A certain degree of cicatricial coarctation already exists, and a complete healing of the ulcer by a continuance of Nature's method will be

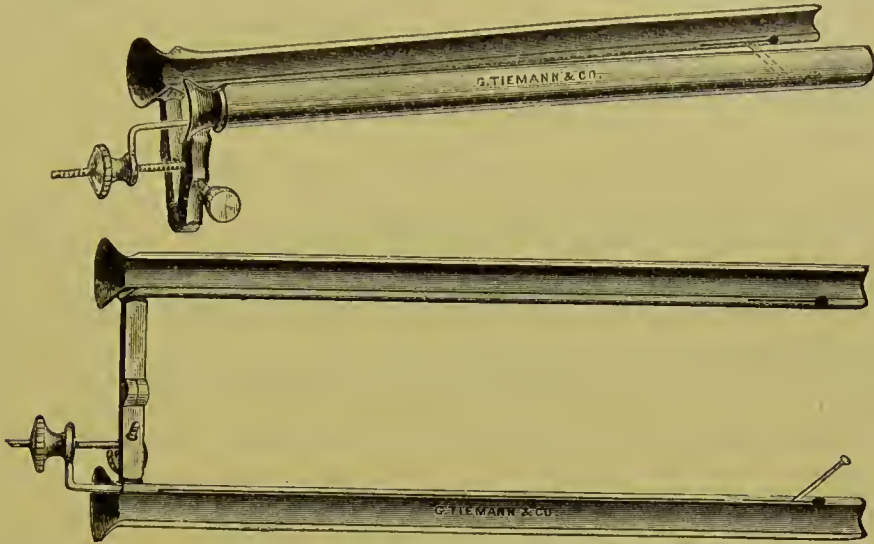


FIG. 25.—The author's bivalve urethral speculum. The figure shows the full extent to which all these specula open for easy cleansing.

effected at the greater expense of the urethra by stricture. Gradual dilatation of the part by use of the sound or the bivalve speculum (Fig. 25) will in the majority of cases be effective, but at so great an expenditure of time that it is not to be recommended.

A thorough linear incision through the hard infiltrated walls and floor of such an ulcer is the only proper procedure. To do this, the speculum is absolutely necessary. It puts the tissues upon the proper degree of tension to facilitate cutting, acting at the same time by its lateral pressure as a hæmostatic; and so by ocular guidance a second incision can be made should the first be insufficient. To do this a small knife, shaped like the gum-lance with long handle, is requisite; but, in order to interfere as little as possible with the line of vision, and to guard against cutting any but the tissue intended, as well as to secure uniform but firm vertical pressure, I recommend my diverging urethrotome (Fig. 26), which has been devised for special use in operations which the urethral speculum renders possible—such as annular strictures of medium and large caliber.

For the past three years I have used this or a modified form of tome for making incisions through the speculum under ocular guidance. There is every reason to believe that many of the operations which have

been and are still being done under tactile direction alone will in the future be relegated to the more delicate sense of sight.

The chronic urethral ulcer which has had this initial treatment of linear incision should then be subjected to gradual dilatation with the

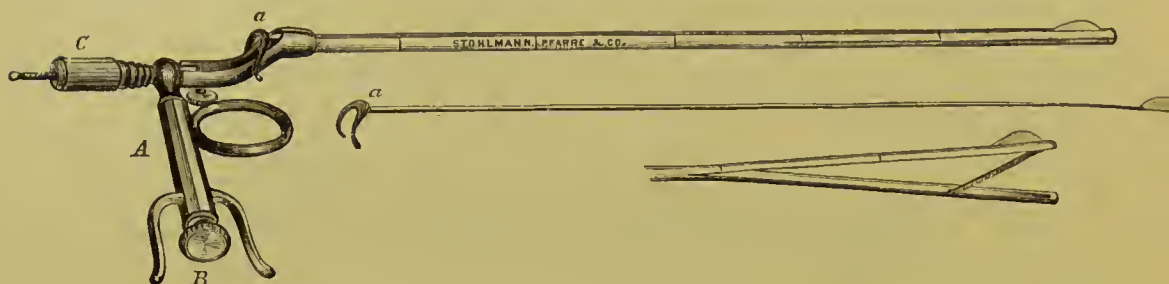


FIG. 26.—The author's urethrotome, for use with the speculum.

speculum, and local application as already described. While speaking of urethral ulcer, although without possession of the data to substantiate the theory, I infer, as elsewhere stated, that a neglected lesion of this kind, occurring in a subject of advanced years and of impaired constitution, may retrograde from its normal tendency to heal as a cicatricial stricture into that rare disease, primary epithelial cancer.

IV. URETHRAL NEOPLASMS.

URETHRAL INITIAL SYPHILIS.

Chancre of the urethra is commoner than is generally supposed, and is undoubtedly the starting-point of many cases of syphilis of unknown origin. It is rare indeed that such an initial lesion occurs at a distance greater than one inch from the meatus. The most common locality for a true intra-urethral chancre is at some point between the extreme limits of the meatus and the fossa navicularis; those occurring at the deeper part of this short portion of the tube are rarer than the more superficial ones.

The earliest subjective symptom of urethral chancre is ordinarily a slight thin discharge, faintly blood-stained, rarely quite purulent. When the last exposure has long antedated (four to eight weeks) this manifestation, it becomes of the utmost importance to positively ascertain the source and nature of this discharge. At this time the patient may also have noticed a moderate impediment to, or, what is more likely, an unusual lateral divergence in, the urinary stream. If this is the case, palpation of the glans penis and the subjacent corpora spongiosum will certainly reveal an induration. The degree of infiltration may be great enough to cause a tumefaction of the overlying parts appreciable to the eye. Again, the lesion may be so small as to make the evidence of palpation doubtful. Under any circumstance, visual examination of the

urethra is positively demanded, for within certain limitations peri-urethral abscess, urethral ulcer, and urethral chancre have symptoms much in common.

A good demonstration of these lesions is afforded by the urethral speculum.

When such a lesion is felt to be in the anterior urethra, a short two-inch instrument will be selected for use. It can be so turned that the lesion will protrude between the wire arms of the speculum.

The protean types of initial lesions, as they appear in the external genitals, may be reproduced within the urethra. However, I have seen but two varieties, six cases in all; five of these presented varying types of the smooth, shining, tense, papular syphilide, with a proportionately slight central destruction and depression. The remaining exceptional case, just within a large meatus, on the roof presented a considerable plaque or area of whitish, slightly friable, greatly thickened mucous membrane, with no erosion or destructive central tendency. The external induration felt by transverse palpation of the upper half of the glans penis was marked. Inguinal adenitis and the subsequent cutaneous manifestations must be depended upon to confirm the diagnosis. But the early discovery of a suspicious lesion within the urethra may prove to be of greatest importance to the patient.

In exceptional cases local applications are desirable, but constitutional treatment will best be deferred until the first appearance of unmistakable secondary manifestations.

URETHRAL CANCER.

Carcinoma of the urethra is usually secondary to cancer of the penis, the prostate, or the bladder. Primary cancer of the urethra is extremely rare. Kaufmann has been able to collect five reliable recorded cases only, in four of which an exact post-mortem and microscopic diagnosis was made. They are those of Schustler, Thiersch, Guyon, Trzebicky, and Guiard.

In all four cases the urethral cancer was found situated in the perineal portion of that tube. In Schustler and in Guiard's cases the perineal swelling simulated an abscess, and led to incision. The carcinoma had evidently undergone colloid degeneration and softening, and masses of detritus had collected in the inclosing walls. In Thiersch and Trzebicky's cases the opening in the perinæum had occurred before the patient reached the hospital. In Thiersch's case the entire urethra had been destroyed; the lower border of the symphysis was exposed, and had already been invaded by the neoplasm. The edge of the bone was so incrustated with urinary salts that, by the catheter, it felt as if an encysted stone were present.

In the cases that were examined post mortem the mucous membrane of the bladder was found thickened and reddened, and the viscous contained purulent urine. The prostate was enlarged, and the mucous membrane of the prostatic and the anterior half of the cavernous urethra strongly injected. A large, irregular, and ulcerated excavation of the urethra, extended into the corpora cavernosa, varying much in size. The walls of the cavity were lined with hard, irregular masses of tissue of a whitish surface when cut, and exuding a plentiful milky fluid on pressure. Abundant pus, mingled with urine, and of a most unpleasant odor, was present in the cavity. In some cases metastatic carcinoma was found in other parts of the body, in others it was not present. The microscope in every case revealed a carcinoma of the epithelial type.

The origin of urethral cancer is from the urethral mucous membrane, and Thiersch has drawn attention to the possibility of its originating in the region of a stricture. Poncet and Paget record cases in which the carcinoma seems to have originated from the margins of an old fistula. A theory has newly been advocated by Pietrzikowski, namely, that the growth originates from the epithelium of the excretory ducts of Cowper's glands. But in the few observed cases of cancer of these glands the urethra has not been directly implicated, and Pietrzikowski's theory lacks post-mortem confirmation. I incline toward the belief that chronic urethral ulcer, when the lesion has failed to heal by cicatrix, following gonorrhœa in old and debilitated subjects, is the most probable cause of primary urethral carcinoma.

Symptoms.—The first symptom noticed is the interference with urination. Dysuria is present in most cases, anuria in some. Catheterization is difficult in all and impossible in some cases. The beak of the instrument seems to get into a large cavity, and to be stopped there. There may or may not be an abscess-like swelling in the perinæum. Pain is usually present, and is referred to the groin. Stricture, fistulæ, and other urethral lesions are either found or the patient gives a history of having had them in the past. The endoscope has been shown by Grünfeld to be useful for the detection of fungating urethral growths of cancerous origin.

Treatment.—Little may be said under this head, since the cases of urethral carcinoma so far recorded have only been recognized so late that there was no question of any radical treatment. It is to be hoped that the more extended use of endoscopy will enable us in the future to recognize and remove the disease at an earlier stage. Most of the cases have ended very soon after the making of the diagnosis—metastases on the lungs and pleuræ hastening the fatal result in Guiard's case.

Nevertheless, the general verdict is in favor of its being a thoroughly

local process. In most cases not only were metastases absent, but even the inguinal lymphatic glands were not involved.

In a single case only, that of Trzebicky, the penis was amputated; the patient died four months later from cancer of the inguinal glands.

URETHRAL VEGETATIONS AND POLYPI.

These rare abnormalities have been endowed with a variety of names, being known as earuncles, polypi, vegetations, fungosities, papillomata, granulations, etc. Our knowledge of their microscopic structure is still too imperfect to allow us to differentiate the varieties that undoubtedly occur, and it is well for us to group them all as fleshy excrecences, earunculae, or polypi.

They appear as intra-urethral vegetations, similar to the commoner growths found upon the glans and sheath of the penis. Thompson saw



FIG. 27.—Urethral polypus.

one at the junction of the prostatic and membranous urethra, forming a pedunculated tumor nine lines long and three or four broad—a true polypus. Their frequent seat is behind strictured portions of the canal.

The **symptoms** caused by these growths are few. Rarely do they cause inconvenience or trouble. A slight amount of discharge and some obstruction to the flow of urine are to be noted. Their recognition is possible, of course, only through the endoscope, where they appear as rounded, smooth, or raspberry-like masses, projecting into the lumen of the instrument (Fig. 27). Grünfeld and Oberländer have given us excellent illustrations of the picture thus presented.

Grünfeld has found that these vegetations may occur anywhere in the canal, and that they may attain a considerable size. Tarnowsky has seen them in connection with urethritis granulosa. They vary in size from a small grain to a cherry.

Treatment is simple and satisfactory. The growths must be torn off by means of the long urethral forceps, the polypus snare, or the polypus scissors. Tedschenko has recently devised an instrument that he calls an endoscopic carunculatome, which is probably very effective when the urethra and the polyp happen to exactly fit the instrument.

I have never seen any of these intra-urethral neoplasms large enough to designate by the name of polypus, but three- or four-millimetre-long papillomatous hypertrophies, with ends of small pin-head size, I have frequently met with. I have found that they were best exposed by the wire speculum, and, as they project between its bars into the open urethral space, they present a perfect opportunity to touch them with glacial acetic acid, under which they rapidly shrink and disappear.

Should the surgeon meet one of these rare polyps of pea-size or larger, its easy removal would be assured by exposing it with the urethral wire speculum, when any of a variety of cutting or seizing instruments would accomplish the extirpation. The point of detachment will also be well exposed by the speculum, for the application of cautery or hæmostatics, if necessary.

V. WOUNDS AND LACERATIONS OF THE URETHRA INFLECTED FROM WITHOUT.

RUPTURE OF THE URETHRA.

Wounds and lacerations of the urethra, coming from without, may be caused in various ways. Wounds proper may be inflicted by any cutting or piercing instrument, by needles, knives, glass, etc. Contused wounds or lacerations of the urethra, with no solution of continuity of the adjacent cutaneous parts, are usually due to direct external violence by a blunt resisting object.

1. **Punctured and Incised Wounds of the Urethra** are not common, that organ being well protected by the pubes, perinæum, and corpora cavernosa. It can rarely happen that the urethra is wounded without concomitant wounding of other structures.

Punctured wounds are usually not serious. In fact, they frequently heal spontaneously. There may be a small ecchymosis under the skin at the external point of penetration, and a slight hæmorrhage from the meatus. They need no treatment.

It is very different, however, with incised wounds. Their gravity varies with their location and their extent. They are almost always

complicated with wounds of the perinæum or the corpora cavernosa, and will therefore receive more extended consideration under that heading.

Nevertheless, incised wounds of the male genitals receive a new significance when the urethra is included in the traumatism, since the opening is usually sufficient to allow the urine to escape and to bathe the raw surfaces, though infiltration rarely occurs. We have learned, indeed, that normal fresh urine is not hurtful, and that its presence does not complicate wound-healing. Certain sequelæ are, however, apt to occur: fistula may supervene if the edges of the mucosæ unite with the edges of the skin, instead of with each other; stricture may be caused by the contraction of the cicatrix of a transverse cut.

Longitudinal incised wounds of the urethra heal promptly, without exception, whether closed by suture or not. Transverse incised wounds generally heal spontaneously, but they invariably leave a stricture.

Treatment.—Kaufmann's experiments speak in favor of immediate union of the edges of the wound in transverse incisions of the urethra. The first step is necessarily the introduction of a permanent catheter, to be retained not more than three days. The sutures are accurately applied over the catheter.

When, as is sometimes the case, it is impossible to pass the catheter into the posterior urethral segment, it is proper to follow Reybard's example, and suture the wound notwithstanding. The patient must then be watched with great care, to see if the urinary passage is patent. At the first sign of infiltration the sutures must be removed. If the case is complicated with a solution of continuity of other penile structures, they must be sutured in accordance with the rules laid down under that heading.

Perineal urethrotomy may become a necessary adjunct in severe cases.

2. Lacerated and Contused Wounds of the Urethra.—Lacerated wounds coming from without are rare. They occur almost solely in conjunction with fracture of the corpora cavernosa during erection, either from a sudden bending of the penis or during violent coitus. Violent pain, hæmorrhage, and retention of urine follow; catheterism is frequently impossible. Urinary infiltration is almost certain to occur, with gangrene and loss of substance of the skin, the deeper parts, and the urethra. The patient may die of sepsis. Skinner (Phil. Med. Times, 1880, page 350) cured a case by multiple incision and permanent catheterism, and Dittel one in whom he incised the perinæum on the eleventh day after the accident, and sutured the separated urethral ends.

Rupture of the Urethra from external causes is, of course, simply a lacerated and contused wound of the urethra that destroys its continuity in part or completely.

Contused wounds of the urethra occur from the effect of blunt vio-

lence which compresses the canal forcibly against the solid and bony parts. They differ much in cause and mechanism in different cases. Terrillon's thesis (Terrillon, *Des ruptures de l'urèthre*, Paris, 1878) is the completest modern *résumé* of the subject.

Bryant has observed contusion and rupture of the urethra 19 times in 1,077 cases of affections of the uro-genital organs, being 1·7 per cent of all cases of the kind. If traumatic strictures be included, the number reaches 54, or five per cent. Nevertheless, urethral lesions of this kind are not very common. From the eleventh to the twentieth year is the most frequent period at which these traumatisms occur.

Etiology.—Most often a fall astride of some object is the cause of the accident. The pendulous urethra is rarely affected, its situation and mobility being such as to protect it. Voillemier recites the case of a man whose pendulous urethra was ruptured by the kick of a horse, and Ballard one of a man who was knocked down by a heavy wagon; in both cases the penis was lacerated against the pubis. In one case the dependent penis was caught and squeezed, and the urethra ruptured, when the patient was shutting a drawer. The accident is more frequent when the penis is in the erect condition. Then, the attempt to break a chordee may cause a lesion of the anterior urethra. The effort to accomplish coitus under certain conditions may also give rise to its occurrence, as Demarquay says, either in consequence of a violent attempt at intromission, or when, during coitus, a false movement produces a rough flexion of the penis against the pubes or perinæum of the female.

Lacerations and ruptures of the perineal urethra are more common, and are most frequently caused by a fall upon the perinæum. This occurs over railings, spars, etc. Perineal blows also, though more rarely, occasion it, such as kicks—especially when the thighs are separated, the body inclined forward, and the perinæum protruded. Again, fractures of the pelvis in which the pubis is involved are a fertile source of contusion and rupture of the urethra. The fixed membranous urethra is the part most frequently injured by the fragments of bone. Even a simple dislocation of the symphysis, causing overriding of the bones, may so drag upon the membranous urethra as to rupture it. The dislocation may only be momentary, the bones returning to their normal position, and yet a urethral rupture by traction has occurred.

The mechanism of these perineal urethral ruptures has received much study. The older authorities believed that they were caused by a direct crushing of the urethra against the lower border of the pubic arch, or of its bulbous portion against the anterior border of the pubis. Cras, in an important memoir, claimed that the urethra, being fixed by the triangular ligament an inch below the lower border of the pubis, could not be crushed by it, though it might be exceptionally compressed against the

face of the pubis, which is placed at an angle of only thirty degrees with the horizon. The contusing force is rarely exactly median; it usually forces the urethra aside laterally, and squeezes it against the descending ramus of the pubis, on which there is a fairly sharp ridge. The firm border of the transverse ligament, a concave fibrous bridle half an inch deep, which extends between the descending rami of the pubis, has been accepted by Ollier and Poncet as the efficient factor. Terrillon, basing his conclusions upon experiments with the cadaver, finds that falling astride of a narrow body capable of being included in the subpubic angle, causes rupture of the urethra by crushing it against one of the ischio-pubic rami. If the body that is fallen on completely fills the pubic arch, the urethra is crushed against the anterior face of the pubes.

Pathological Anatomy.—The increased frequency of early operative interference has given us of late years opportunity to observe the condition of the parts immediately after the injury. To this has been added the results of experimentation upon animals and upon the cadaver. It seems certain that laceration and rupture of the urethra may occur in at least three different forms or degrees.

The first is what is designated by Reybard as interstitial laceration. Here the spongy tissue only is involved, the internal mucosa and the external fibrous coat escaping entirely. The spongy tissue of the urethra seems to be especially friable, and such lacerations and partial ruptures are produced by influences that would not affect other tissues. Reybard believes this to be due to the fact that the trabeculæ of the spongy tissue form the walls of the vacuoles containing blood, and this incompressible fluid, when subjected to sudden contusion, bursts its walls. Hence arises a blood-pocket, which can not extend externally on account of the incompressible fibrous sheath, and which therefore projects into the cavity of the urethra, narrowing its lumen.

In other cases there is, besides this interstitial rupture of the spongy body, a rupture of the mucosa and submucosa. The sanguineous interstitial pocket then communicates with the urethra, blood passes out from the urethra, and urine enters the lacerated cavity. The rupture of the mucosa is usually incomplete, since sufficient violence to completely rupture it usually causes the third degree of laceration, or entire rupture.

In still other cases, all three structures—the mucosa, the spongy tissue, and the fibrous envelope—are ruptured, and the cavity of the urethra communicates with the tissues of the perinæum. A part only of the circumference of the urethra may be affected, forming an incomplete rupture. The walls of the canal are usually extensively lacerated, but in almost all cases there remains a bridge of sound tissue connecting the upper parts of the two fragments. This bridge is of great importance for catheteri-

zation and operation. The edges of the urethra retract, and leave a cavity filled with blood-clots. When the rupture is complete, and the entire urethra is transversely divided, the retraction is more marked, and there may be a space of half an inch between the two ends. In a recent rupture this cavity is filled with clots; later, it contains a mixture of pus, urine, and blood. The torn ends of the mucous membrane curl up and wrinkle; the lacerated spongy body is irregular and filamentous.

Such complete ruptures occur oftenest in the membranous urethra, where the walls are thinnest and the surrounding structures most feeble. In the penile urethra it is much rarer.

The exact seat of the laceration or rupture in the perineal urethra has been much discussed. All the later authorities—Guyon, Cras, and Terrillon—agree that the bulbous region is most commonly involved. Ruptures in the prostatic region do not occur; those of the membranous portion are rare except with fractures or dislocation of the pelvis. Ruptures of the pendulous urethra are exceptional.

The recognition of the extent and exact seat of the laceration during life is, however, a matter of much difficulty.

Even with the most extensive concomitant lesions of the perineal organs the skin usually escapes. A few cases only are on record where the external integument was broken through. Fracture of the pubis may be present and may be primary; in other cases the urethral lesion precedes the fracture. The urethral lesion may communicate, directly or indirectly, with the fractured bone, when there will be danger of osteomyelitis, or the fracture may be simple. The tissue of the corpora cavernosa is frequently lacerated, but their tough fibrous envelope preserves them from serious damage, in most cases. Sometimes these corpora are torn away from their ischio-pubic attachments, and the subpubic ligament is frequently ruptured. More or less blood is always effused.

Symptoms.—Spontaneous pain is usually slight compared with the extent of the damage done. Shock, however, may be quite severe at first. Still, if the bones have been splintered or chipped, there may be marked pain. Pain on pressure is constant, and affects the entire injured area. Moving the patient causes pain, located in the perinæum, and radiating to the vesical neck and the glans. Increase of pain means supervention of a complication—phlegmonous inflammation of the injured part, or urinary infiltration.

Most important are the symptoms referable to the evacuation of the urine. In about one quarter of the cases the patient can still urinate, though in most of these retention comes on in a few hours or days. In three fourths of the cases there is absolute retention. In a very few cases there is a temporary retention, with subsequent re-establishment of micturition. The retention is easily understood in the cases of

total rupture. The separation and dislocation of the urethral ends, and the accumulation of coagula between them, obviously render urination impossible. In the lesser degrees of contusion, intra-urethral hæmorrhage may likewise block the passage, or a blood collection outside the canal may so compress it as to render it impervious. An injury to the transversus perinei muscle may also have some effect. A very small proportion of the lightest cases show no disturbance of micturition at all; for in the cases where retention comes on some time after the accident it is due to compression from recurrent hæmorrhage, or inflammatory swelling from infection of the injured tissues. Finally, temporary spasm of the membranous urethra may cause retention in the mildest cases.

Urethral hæmorrhage is an important symptom of the injury. Sometimes it is so small that only a few drops of blood, or a coagulum, appears at the meatus; but usually there is a spontaneous hæmorrhage amounting to a couple of ounces or so, and appearing in drops at the meatus, during the first few hours after the injury. Serious hæmorrhage is rarely seen; yet Paul cites a case in which the hæmorrhage lasted for six days. But the intensity of the hæmorrhage bears no relation to the extent of the injury. In injuries to the perineal urethra there may be much blood effused that does not find its way to the meatus. It collects at the site of the injury, causing the primary swelling, while a coagulum may block up the urethra and prevent the blood appearing externally. The first urine evacuated with the catheter is usually mixed with blood which has trickled into the bladder. The presence of blood, then, is a symptom of much importance, whether found at the meatus or in the urine, and shows conclusively the presence of a solution of continuity of the urethral wall.

The swelling is at first limited to the perineal region, and appears as a rounded tumor situated between the scrotum and the anus, and as large as or larger than a hen's egg. The skin covering it is normal and elastic, though ecchymotic patches may appear. The swelling is due to hæmorrhage, and will gradually increase as long as that lasts. Limited by the superficial fascia, it may spread on to scrotum and penis. In the worst cases the blood tumor can be felt *per rectum*, and occasionally pressure upon the tumor will cause blood to exude from the meatus. Rupture in the penile region is followed by a swelling which is generally slight, in the form of a more or less regular collar surrounding the canal.

Course, and Complication.—In the mildest contusions of the urethra the effused blood causes a retention that is readily relieved by the catheter. As the blood is absorbed micturition becomes free, and, like any other subcutaneous contusion, the part usually returns to the

normal state. Sometimes, however, the sanguineous tumor becomes inflamed, suppurates, and forms an abscess which opens either into the urethra or through the skin, or both ways.

But when the injury to the urethral wall has been greater the complications of urinary retention and wound infection render the accident much more dangerous, and especially is this the case when the rupture has been complete. When the patient attempts to micturate, the urine flows into the contused perineal tissues and spreads thence through the loose meshes of the connective tissue, and infiltration of urine ensues. Where the injury has caused a solution of continuity of the perineal skin this is much less likely to occur, since an outlet is provided for the renal secretion. We need not here describe the course of infiltration of urine. Suffice it to say that the urine brings with it something which irritates the already damaged perineal tissues—they inflame, and suppurate; the skin sloughs. *Fistulæ* are thus formed.

Not less serious complications arise from the fact that the urethral wound, in spite of its subcutaneous nature, is usually infected. The source of this infection may be micro-organisms conveyed by urine from the bladder, or the pathogenic micro-organisms known to exist in even the normal urethra. But if auto-infection does not happen, septic germs are very prone to reach these lesions from without by means of catheters and other urethral instruments.

This infection spreads almost inevitably to the bruised perineal tissues in connection with the wound, and results in perineal abscess. This is a serious and very common complication of urethral contused and lacerated wounds, and is usually of a peculiarly malignant nature. The intact skin prevents the escape of the noxious materials, and the urine in contact with the bruised tissues increases the danger; for, while quite fresh and healthy urine may be aseptic, decomposition sets in so readily in this fluid that its presence constitutes one of the chief dangers of the condition. Urinary infiltration is also very liable to occur, and septic general infection leading to a fatal result is but too frequent. *Cavernitis*, *phlebitis* of the pelvic bones, and *pyæmia* are occasionally seen.

The most favorable termination of the average case, after the spontaneous or artificial opening of the mass, is the expulsion of the dead tissues and inflammatory material by suppuration and slow healing with cicatricial formation. Spontaneous cure has been very rarely observed, and that only in the lightest cases.

As regards the opening in the urethra, such cicatrix formation is of extreme importance. The extent of the original injury by no means corresponds to the ultimate defect. The bruised margins of the urethral orifice become necrotic and slough away, and the resultant scar may be so extensive as to seriously compromise or entirely close the urethral lumen.

Hence cicatricial stricture, and that of the worst form, is an extremely common sequel to these injuries.

Complete rupture of the urethra leads to extensive granulation between the divided ends, and the formation of a circular retractile scar, giving rise to one of the most serious of strictures, followed by fistula-formation and other troubles.

Diagnosis.—When a patient has sustained a perineal injury, the possibility of a urethral lesion must always be kept in mind. If blood appears at the meatus the diagnosis is almost certain. If none is there, pressure on the perinæum may cause its appearance. In the entire absence of meatal hæmorrhage the patient should be made to urinate, the perineal swelling being watched while he does so. If the tumor increases during the act, and the patient experiences severe pain, the urethra is probably injured, and all attempts at voluntary micturition should be stopped at once. If the tumor is not increased by urination, and if the urine contains no blood, nothing more than a urethral contusion is present. But retention of urine often accompanies a simple contusion, as we have seen, and here the possibility of catheterization with the absence of hæmorrhage will clear the diagnosis.

When a lesion of the urethra has been thus demonstrated, a well-oiled and disinfected catheter is to be introduced. It may reach the bladder, or it may strike the symphysis and only reach the bladder after careful manipulation; or the bladder may not be entered at all. When catheterization is easy, a small contusion only is usually present. But in some very bad cases there is no difficulty in reaching the bladder, even when subsequent events show that the urethra is completely ruptured. In a recent rupture a number of fibers of submucous connective tissue may unite the torn ends of the canal, and these serve as a guide to the catheter; later, however, when infection has occurred, these, as well as the ends of the urethra and the neighboring tissues, become gangrenous and disappear.

In case the catheter passes out through a urethral wound into the neighboring tissues, we should at once try to get an accurate idea of the extent and limits of the damaged tissues, using the instrument as a probe.

Inflammation of the injured perineal tissues is recognized by the pain and fever, the local tension and redness of the skin, the neighboring œdema, etc. The various complications are to be recognized by their appropriate symptoms, elsewhere considered.

Prognosis.—Kaufmann places the mortality of all urethral contused and lacerated wounds, with rupture, at fourteen per cent. In the lightest cases, where there is interstitial rupture, or simple fraying of the mucosa, the prognosis is good; the symptoms often disappear, and the case progresses rapidly to recovery. In severer cases, where the urethral

walls are torn through and the spongy tissue is involved in the wound, the prognosis is graver; complications are apt to ensue. In the worst cases, where the rupture is complete, the effusion of blood and the laceration of the tissues almost inevitably cause infiltration of urine—a most serious affair. The immediate prognosis is grave, and the ultimate one also serious, since cicatricial stricture with all its consequences inevitably supervenes.

The cases of all degrees of severity which are accompanied by primary retention are more favorable than those in which the patient can micturate, since they demand and receive immediate medical care—i. e., catheterization—the very thing to prevent that most dangerous of the complications of the condition, infiltration of urine. Cases in which the urine can still be spontaneously evacuated are frequently treated expectantly for some time, and eventuate badly. Contusions and ruptures of the urethra caused by pelvic fractures have been found to be the most unfavorable of all.

Treatment.—A broad distinction must be made between the cases of very slight gravity and the more severe ones, since it would in certain cases be absurd to proceed at once to operative measures. When the symptoms point to simple contusion or to interstitial rupture, temporizing measures are allowable. Pressure and cold applied to the perinæum, and the use of a flexible catheter to overcome the retention, are all that is necessary. But the surgeon must watch the patient closely, and on the first sign of the existence of more serious lesions proceed to take vigorous measures.

In but few cases that come under medical care will the above mode of treatment be answerable. The indications, however, for immediate interference are usually peremptory.

The hæmorrhage is rarely sufficient to demand immediate attention; cold and pressure will soon keep it within bounds. But if retention of urine sets in, we receive a positive indication for interference within a very few hours after the accident. In that case catheterization must at once be resorted to. If it be successful, it is the custom of some surgeons to leave the instrument *in situ*, and thus to drain the bladder. The results of this method of getting rid of the urine have not been very brilliant. Duplay advocates it in some cases; but Kaufmann rejects it, and reports a mortality of thirteen per cent in those cases in which the catheter was retained; for in more than half the cases in which this plan of treatment was inaugurated it had to be abandoned on account of complications—abscesses and infiltration.

Permanent catheterization is probably the commonest plan of treatment to-day. It provides for urinary outflow and puts the urethra at rest. But it also directly carries the infective agent to the wounded

tissue; for, as we have seen, it is practically impossible to make the catheter an aseptic instrument. It also hinders the outflow of effete material through the urethra, thus closing up the only avenue for its escape. But the most conclusive arguments against its use are the results obtained. Urinary infiltration and septicæmia, the worst complications that we have to fear, are not hindered by it. The results are bad, and as a general plan of treatment permanent catheterization is to be absolutely rejected. Occasional catheterization is proper, of course, and is to be used in all cases of retention in which it is practical; and in simple contusion of the urethra with retention—eases a degree severer only than those in which the expectant treatment is allowable—catheterization must be regularly repeated until the blood effusion that presses upon the urethra is entirely absorbed. Meanwhile a most vigilant watch must be kept upon the perineal tumor and on the temperature. Inflammatory disturbance around the tumor and increase of bodily heat being indications for immediate interference.

Puncture of the bladder has been often done in those cases in which catheterization proves impossible; and with a perfectly aseptic needle the operation is harmless, and may well be employed when, from any cause, ordinary catheterization is impossible. But it is only a temporary measure; though it may be repeated a number of times, it does not constitute a treatment for the lesion. It may be preferable to use aspiration of the bladder from the beginning, instead of catheterization—it is possibly less harmful; but the statistics of the French surgeons, and especially those of its advocate, Mallière, do not show that it is less liable to complications than is the retained catheter. Lately some have adopted the plan of permitting the cannula to remain *in situ* in the punctured bladder, or have replaced it with a permanent soft catheter. But the mortality under hypogastric puncture has been over nineteen per cent, perineal abscesses have been frequent, and the results obtained can not compare with those obtained by perineal section.

Perineal section—or, rather, immediate external urethrotomy—fulfills all the indications for the injury. It gives an external and convenient opening for the torn and bruised area of tissue, allows drainage for the effused blood, the purulent secretions and the urine, and presents an opportunity to treat the urethral wound directly. The objection, that by immediate perineal section we convert a subcutaneous into an open wound, is a fallacious one. These traumata are not subcutaneous, although the perineal skin may be unbroken; the urethra affords an open door for the advent of disease. As a matter of fact, they are open wounds under good conditions for infection, and bad ones for antisepsis and drainage. The sole rational treatment consists in free opening, removal of necrotic tissue, and drainage; and it has to be done, finally, in a large number of cases in which other methods are first tried. Of course, if done later, it

is difficult to recognize the urethra in the midst of the sodden, inflamed tissues; it is comparatively easy if done early. Thus we get an opportunity to do what is necessary for the ruptured organ itself.

Statistics fully bear out the correctness of these hypothetical considerations. We have seen that the mortality in cases treated by vesical puncture was 19 per cent, and in those treated by permanent catheterization, 13·6 per cent; in those in which the early perineal incision has been done it has been only 8·75 per cent. Perineal incision is not to be reserved for the worst cases; it is to be applied to all save those of the very least degree.

The operation is a simple one: The patient is laid on his back in the lithotomy position; the perinæum is shaved and thoroughly cleansed. Local anæsthesia may suffice for adults. The perinæum is incised in the median line, the cut beginning about two inches in front of the anus, and reaching nearly to its margin. First the skin, and then the superficial fascia, are incised. If the injury has affected the bulb of the urethra, the blood effusion will be reached under the superficial fascia; if the membranous portion is injured, the incision must be deepened posteriorly and the membrana propria perinei freely divided. The clots are now turned out and the cavity thoroughly washed; necrotic fascia is to be cut off; open vessels are to be tied; while compression will stop the oozing, and hot sponges or the thermo-cautery end any hæmorrhage that there may be from cavernous tissue.

The catheter is then passed, and the course of the urethra in the wound carefully followed. When the urethra is continuous, it is easy to detect the amount and nature of the injury it has sustained. If it is severed, the torn distal end must be smoothed off with scissors and the proximal end searched for. This is almost always a difficult and apparently in some cases an impossible task. The free proximal end of the urethra forms a movable round cord, bleeding freely. If the patient can be induced to pass a few drops of urine, the urethra will soon be apparent; if the patient is narcotized, pressure upon the bladder will cause a few drops to exude. In the later stages, when a large abscess has formed and the entire necrotic mass is of a dirty, greenish gray, the difficulties are increased. As soon as the proximal urethra is found, a catheter is passed into the bladder and the viscus is emptied.

If the urethral wound is a partial rupture, we can expect spontaneous healing after the perineal opening has been made; the continuity of the urethra being preserved, there will be no special difficulties in the subsequent catheterism; but if the rupture has been complete, the two stumps of the urethra are united by a mass of cicatricial tissue, which forms a stricture of the most intractable and resilient character. König has recently got good results by the total excision of such strictures, followed by

the suturing together of the ends of the tube. Suture is to be recommended also, when feasible, in this class of cases of complete ruptured urethra that we are considering. Even partial success in obtaining union by suture will give us much better results than we could otherwise obtain. When there is extensive contusion and laceration of the urethra it is, of course, impossible to suture the ends unless they will permit of some trimming.

The perineal wound is to be washed, powdered over with iodoform, and its edges anointed with borie-acid ointment; it is then stuffed with Lister gauze retained by a T-bandage. The patient urinates for the first few days through the perineal wound, then through the urethra or catheter. The parts must be thoroughly irrigated with boro-saline water, and a new bandage applied after each micturition. Defecation must be prevented as much as possible for the first few days by light feeding and opium. On the eighth day a catheter or sound should be introduced, and as large an instrument as possible passed every few days thereafter. The perineal wound usually takes three to six weeks to heal.

If the rupture is a complete one and occurs in the bulbous urethra or anterior to it, the same operation of suturing the severed ends of the urethra may be advantageously supplemented by perineal urethrotomy reaching the bladder for urinary drainage through the membranous urethra. Under these circumstances an aseptic rubber tube can be left in the anterior urethra to act as an internal splint or support to the sutured wound. The opening in the membranous urethra will both minimize the danger of urinous contamination of the traumatic urethral lesion and systemic infection. If the rupture is posterior to the bulb, and so extensive as to jeopardize the chances of successful suturing unless the urine be deflected from its normal channel, suprapubic cystotomy for direct drainage or for ureteral catheterization may be done. The guide for the cystotomy in this case is the tilted-up point of a sound passed after the severed proximal end of the urethra has been found by perineal incision.

Cases which are still further advanced, in which septic infection has occurred, are to be similarly treated by incision and disinfection. Permanent irrigation, or particularly the permanent bath, is to be recommended in these cases. The other complications, urinary infiltration and cystitis, are considered at length elsewhere.

VI. WOUNDS AND LACERATIONS OF THE URETHRA INFLICTED FROM WITHIN.

The urethral canal may be injured by foreign bodies introduced into the canal by the patient himself; by the use of faulty urethral instruments; by excessive urethrotomy, resulting in cicatricial curvature; and by urethral calculi, to be considered elsewhere.

1. Injuries caused by the Introduction of Foreign Bodies.—Needles and pins, and less commonly hairpins, are among the most frequent foreign bodies thus met with. Pipe stems, slate pencils, metal chains, a child's tooth, chewing-gum, and shoe strings are some of the other objects too numerous to mention. The satisfaction of erotic impulses is the usual cause of their introduction. They are most often found at the period when sexual feelings are awakening, at the thirteenth to the fifteenth year, and next most often in elderly individuals, who seek by these means to arouse their lost desires.

Objects thus introduced purposely or accidentally show a marked tendency to work their way into the deeper portions of the urethra and to reach the bladder, where they frequently form the nucleus of stone. Opinions have varied as to the cause of this phenomenon. Motions of the organ in various directions tend to the backward displacement of an elongated object in the penile urethra. In the membranous and bulbar urethra muscular forces come into play. The power of these forces is quite considerable.

Elongated foreign bodies, if thin, are not displaced by the stream of urine. Larger bodies may occasionally be expelled by micturition, or they may completely close the urethral canal.

Symptoms.—These depend upon the diminution or closure of the urethral canal, and the irritation of the urethral walls caused by the foreign body. Burning and pricking pains in the canal, often radiating to the bladder and glans, and intensified by urination or attempts at it, are the consequences of the mechanical irritation. Urination is difficult or impossible, in accordance with an obstruction that is partial or complete.

As a rule, foreign bodies in the urethra cause such discomfort that they are speedily extracted. If, however, they remain for any length of time *in situ*, they undergo changes similar to those undergone by foreign bodies in the bladder—they become incrustated with lime salts. This leads to a gradual change of shape and increase of size; the urethra is finally perforated by pressure, and the foreign body lies in a kind of pocket communicating with its cavity. Cases have been seen in which sloughing has occurred, and the foreign body has been thus expelled.

Diagnosis.—The history, the location of the foreign body, its size and hardness, are the factors that render the diagnosis easy or difficult. In the penile urethra external palpation is usually efficacious, especially if the foreign body is hard. In the membranous and prostatic urethræ rectal palpation will often help us, even the projection of a lengthy foreign body into the bladder itself being perceptible by this means. Sounds and catheters are to be employed as little as possible for diagnostic purposes, since, no matter how carefully employed, they always tend to push the foreign body still farther from the meatus. Now that visual examination of the urethra has been perfected, the detection of any foreign body is easy. The introduction of a Klotz tube or Brown's speculum will at once reveal the nature and position of the object.

Prognosis is good. The foreign bodies can almost always be readily extracted, nor have any untoward after-results been observed. But a single fatal case is on record (Henry). The patient was seventy-eight years old. The foreign body was extracted, but a false passage was made, and the patient died of septic infection. Foreign bodies have remained in the urethra for months and even years, and in very old persons, yet they have always been successfully extracted when surgical aid was invoked.

Treatment.—The nearer the meatus the object lies, and the less projecting angles and irregularity of form it has, the easier will be its extraction.

Many of them can be removed by any of the urethral forceps, of which that of Mathieu is the best. The articulated eurette of D'Etioles is effective.

Needles, etc., can usually be readily removed by the forceps. A needle, and even a pin, can be forced through the urethral wall until its shaft can be seized externally. It is now under control, and its head can be readily grasped by the urethral forceps, and the pin withdrawn through the meatus. The large, straight, open-end lithotrity tube has repeatedly been used with success in the removal of foreign bodies from the urethra, the finger being passed into the rectum for occlusion of the membranous urethra; the urethra is now slightly distended with water through the tube, when quick aspiration with the bulb will suck up the object sought.

Larger foreign bodies, or those whose shape or fixation render the above method of extraction inapplicable, must be removed by urethral incision. The operation is the same as for urethral calculi, and will be described under that heading.

The employment of any of the previously mentioned grasping instruments will be greatly facilitated by first introducing the urethral speculum, which by a full dilatation of its tips will spread the mucous

membrane away from the object, should it be large, and permit a better insertion of the forceps blades between the urethral walls and the object. It is to be presumed that the speculum, with its independent base and tip control, would alone be adequate for the extraction of many foreign bodies; by it the canal can be spread to its fullest extent. When this is seen to be sufficient and well adjusted to the foreign body, simultaneous pressure on the object, through the external covering of the urethra and the speculum, would force the object into the instrument's wire arms, when, by relaxing the spread of its tips, it would act as a forceps for withdrawal of the object.

2. Injuries caused by Faulty Urethral Instruments are essentially either contused or incised wounds inflicted from within. They do not materially differ from similar injuries coming from without, save that injuries to the external soft parts are absent.

Longitudinal incised wounds universally heal promptly. Even when unsutured, and untreated, this is the rule.

Transverse incised wounds may also heal spontaneously, but they rarely do so without causing a ring-formed stricture of the urethra.

Contused wounds caused by instruments do not differ in their course from ordinary contused wounds as treated above.

The treatment in the most serious of these cases consists of the introduction of a retained catheter.

3. Injuries caused by Excessive Urethrotomy, resulting in Cicatricial Curvature.—Curvature of the penis has occurred in a considerable number of cases. When more than one stricture is divided, and the incision is made deep enough to show hæmorrhagic extravasation into the serotal and penile connective tissue, this serious complication of curvature is to be apprehended. Otis mentions three such cases, but says they caused no trouble, being apparent only during erection, and passing away in all cases in from two months to a year. I have seen several cases which, after reaching a certain stage of improvement, promised to remain during life.

These curvatures are due to a cavernitis of chronic course, with considerable exudation into the meshes of the cavernous tissue. If this exudation is unilateral, the organ in erection will be bent toward the affected side. This may be so excessive as to render coitus impossible.

Much can be done by treatment for these subjects of chronic cavernitis. Moist warmth is efficacious, as is also the envelopment of the penis in rubber tissue, which has the effect of a continuous bath. Massage, withunctions of iodide of potash, mercury, and iodoform ointment, will help resorption. Dittel claims by these means to have always improved and frequently cured such cases.

VII. URETHRAL FISTULÆ.

A urethral fistula is an abnormal opening in the urethra through which the urine escapes partially or wholly during micturition. Occasionally they are congenital, being developed during intra-uterine life, and follow a mechanism exactly similar to those that occur later.

Urethral fistulæ may open externally either into the rectum or on to the skin. This dermal opening may be either on the penis or in the perinæum. We may therefore divide urethral fistulæ into three classes:

1. Urethro-rectal fistulæ.
2. Urethro-perineal (scrotal) fistulæ.
3. Urethro-penile fistulæ.

1. **Urethro-rectal Fistulæ** are much the least frequent form of the malady. The urethral orifice is most frequently seated in the prostatic urethra, less frequently in the membranous portion of the canal. It is usually single and narrow, and is always situated at a higher level than is the rectal opening; hence, while urine flows freely into the rectum, fecal matter does not usually ascend to the urethra. The fistulous tract is narrow and tortuous; its walls are indurated and calloused. The rectal opening can usually be seen through the speculum as a small opening in the midst of a reddish rosette of the mucous membrane. Occasionally the rectal opening is large, and there is a true defect of the recto-urethral septum.

Etiology.—Lithotomy operations, the lateral and median, have sometimes opened both the rectum and the urethra; incisions through the prostate, if made too extensively, have been the cause. Urethral foreign bodies have perforated the urethro-rectal wall and left a fistula; rectal foreign bodies have done the same. Prostatic abscesses and prostatic calculi, causing ulceration, have also occasioned it. Cancerous and tubercular degeneration of prostate or rectum has not rarely been an efficient agent. The extreme rarity of deep membranous traumatic stricture renders stricture an unusual cause of urethro-rectal fistula; but a coexisting stricture in any part of the canal will, after the establishment of fistula by some other means, become an important factor in augmenting the trouble, and an obstacle, while it exists, to any of the methods of cure.

Symptoms.—The chief of these is the intermittent passage of urine from the external orifice of the fistula. This only occurs during micturition, and the point is an important one to distinguish the condition from vesical or uretal fistula. The amount of urine that passes through the abnormal opening varies much. If the urethra is free and the fistula small, it may only be a few drops; if the urethra is much occluded, most of the urine may be passed per rectum. The urine flows from the fistula

during micturition, but it may in exceptional cases be accumulated and retained for a time in the rectum. Flatus not uncommonly escapes by the meatus, and sometimes, though rarely and with much pain, solid fecal matters pass out per urethram. Semen has been known to pass into the rectum in a marked case of the kind.

Examination per rectum will frequently reveal the posterior opening to the touch alone. With a bivalve or Sims rectal speculum and a probe it can always be found, and is usually surrounded by hard, callous folds. A metallic sound having been introduced into the urethra, a probe is passed into the fistulous opening as found per rectum, and the internal orifice of the fistula is decided by their meeting. In place of the sound the endoscopic tube or urethral speculum offers great advantages when the urethra will admit them.

Diagnosis follows from the above. A vesical fistula is distinguished from a urethral fistula by the fact that in the former case the urine escapes continuously from the abnormal orifice, and not alone during micturition.



FIG. 28.—The author's long curved urethral digit. *A*, movable probe-tip for upper segment of posterior urethra; *B*, movable probe-tip for under segment of posterior urethra.

Injecting colored liquids through a catheter into the bladder will also help to a decision. The curved urethral digit (Fig. 28) will be of service in detecting the locality of the urethral opening. When permissible, visual examination of the urethra is valuable.

Prognosis.—This depends largely upon the cause. Those due to tuberculous and cancerous processes or extensive suppuration and other grave conditions are usually incurable. Traumatic fistulae are of better prognosis, and have been known to close spontaneously in a few cases.

Urethro-rectal fistulae are grave also in regard to the conditions that they cause. The irritation of the rectal and vesical mucous membrane leads to inflammatory conditions of a chronic nature in both organs. The patient's general health may be gravely involved.

Treatment.—If there be a stricture of the urethra, it must be removed by the usual means as an essential preliminary to all treatment of the urethro-rectal fistula itself. Our next object is to protect the fistulous canal from the irritation of urine, feces, etc. Regular catheterization will dispose of the urine, but it is less easy to control the feces and

gas. Duplay advises the use of an œsophageal tube, or of a silver cannula provided with an apron, to close the fistulous tract during the intervals of defecation.

As regards the fistulous tract itself, an attempt may be made to close it by caustics applied to its rectal opening—chemical caustics, or the electro- or thermo-cautery. Only very narrow fistulæ are suitable for such treatment, and only in rare cases does it succeed.

Another and better recourse is the operative procedure, which, however, affords but a fair prognosis. The difficulties inherent to the operation are very great, and the necessary contact of the wounded surfaces with urine, feces, and gas render healing slow and imperfect.

A modified Sir Astley Cooper's operation is the simplest and probably the best. A grooved sound having been passed to the bladder, a median perineal incision is made through the membranous urethra. The point of the probe, which has been previously passed from the rectal opening through the fistula to the urethra, is now felt for. The urethral orifice of the fistula thus found is freely cut down, so as to be continuous with the existing perineal incision. If old and much calloused, this portion of the fistula should be everted. Now an incision continuous with that in the perinæum is made, so as to bisect the remaining fistulous tract at some point in the recto-vesical septum, the presence of the probe still acting as the objective point. Additional evertment in both directions is to be done when the probe is reached. The bottom of this wound is firmly packed with iodoform gauze, also leading some of the same gauze into the groove caused by slitting the urethral orifice of the fistula. A full-sized drainage-tube, or short, soft catheter, is led through the perineal wound into the bladder and there retained.

To secure cleanliness and favor repair of the fistula, frequent dressings will at first be requisite.

If this operation should fail in curing wholly, it will probably succeed in effecting a closure of either the urethral or the rectal half of the fistula. If the latter should remain, it can, as a secondary step, be cured by the ordinary cutting operation for complete anal or rectal fistula.

The success of this operation may be enhanced by the use of a fine platinum probe in place of the silver one, making use of it when reached by dissection in the mid-perineal region for an electric-cautery arc, by seizing it here with an insulated clamp electrode, then making a similar connection by the opposite pole with the platinum probe as it protrudes in the urethra. Having cauterized this half of the fistulous tract, the urethral electrode is conveyed to the rectum, for seizure of the platinum wire as it there protrudes, thus completing the cauterization.

In very exceptional cases this same operation of Cooper's may be made more promising by a simultaneous suprapubic cystotomy, to permit

of two or three days' permanent catheterization of the ureters, leading the distal ends of the catheters out through either the suprapubic or perineal wound—preferably the latter. It is probable that catheterization of the ureters will shortly become a feasible procedure to effect through the perineal wound alone. Advanced cancerous or tubercular disease of the rectum or prostate, of course, counterindicate all operative procedure.

2. Urethro-perineal Fistulæ.—These are the commonest of the urethral fistulæ. Often they are multiple, as when they arise from extensive urinary infiltration. Or a fistula single at first may give rise to others; a small quantity of urine remains behind in the tortuous tract, inflammation arises, small abscesses form, and secondary sinuses appear.

The urethral orifice of these fistulæ may be large and funnel-shaped or narrow and slit-like. It is usually single, though it may be double or even multiple. On the cutaneous surface, on the other hand, there are usually a number of orifices scattered over scrotum, perinæum, and the root of the penis. Instances occur in which the pus travels far, and openings of sinuses are found in the groin, the thigh, just above the knee, the buttocks, and the lumbar and the hypogastric regions. The sinus itself varies much in length, but is almost always irregular, with pus and urine pockets and blind *cul-de-sacs* at various places. Its walls are usually lined with a smooth, red, and shining membrane.

Profound alterations of the soft parts occur sooner or later in all these cases; and even when the normal caliber of the urethra has been restored, and the urine follows its natural channel, the fistula may persist, and cause continually further trouble. Thus, there is always marked induration along these tracts if they have existed for any time, palpable as a thick, fibrous cord, or even as distinct nodular masses. Calculi are not infrequently found in them, originating perhaps from the bladder or prostate, but caught in the fistulæ, and increasing there by the continuous deposition of urinary salts. In some cases these salts incrust the walls themselves.

Etiology.—Large abscesses, extensive urinary infiltrations—such as follow ruptures of the urethra and perineal contusions—are the common cause of these fistulæ; while lithotomy, external urethrotomy, and clean-cut wounds are rarely followed by them. Glandular and peri-urethral abscesses, such as occur in simple or virulent urethritis, and in which the abscess empties both externally and into the urethra, may originate them.

But the commonest of all causes is the presence of a traumatic or inflammatory stricture, which may readily engender an abscess, a urinary pouch, infiltration of urine, and even immediate rupture of the urethra. Urinary fistulæ are the necessary sequelæ of such accidents.

Symptoms.—More or less urine flows through the abnormal openings during micturition; sometimes almost all of it does so. A mucous

purulent fluid exudes from the urethra in the intervals of micturition, its quantity depending on the extent and number of the tracts, the diverticulæ, etc. The spermatie fluid usually escapes partly by the normal and partly by the abnormal opening. The appearance of the external orifices has already been described. The hard, fibrous cord surrounding the fistula is sometimes very apparent, especially in those running through the loose serotal tissues.

Diagnosis.—Occasionally so little urine escapes through the abnormal openings, and that so mixed with mæco-pus, that it is difficult to decide if the exuding liquid is urine at all. If the urinous odor does not decide it, we can compress the penis at the moment of micturition, so as to force the urine through the fistulous tracts.

Combined catheterization of urethra and probing of the fistula may be necessary to complete the diagnosis. If the sinus is not too tortuous, we can thus gain fairly exact ideas of its direction, length, and dimensions. Colored liquids may be injected into the tracts or urethra in cases of doubt. The straight urethral digit (Fig. 21) and endoscopy are aids in the diagnosis.

Prognosis.—This depends much on the location and the nature of the fistula, and its cause. The original disease, usually a stricture, must be taken into account. The formation of new abscesses in the penis and scrotum, the appearance of urinary infiltration, and of erythema of the skin, also influence it. In general the prognosis is doubtful.

Treatment.—Futile attempts to cure these fistulæ are usually made, when they are first treated, with various injections of silver, iodine, and hydrogen peroxide, as well as the thermo and electric cautery, scarifications with barbed probes, etc. Ineffective as these are as initial resources, they all become valuable aids when used as auxiliaries to the prime requirement—namely, restoration of the urethra to its normal caliber. Some operators are satisfied to attempt this by internal urethrotomy and the retained catheter. In the exceptionally simple cases this may suffice, but even here it is preferable, and in the severer cases it is necessary, to supplement internal by external urethrotomy, thereby gaining free vesical evacuation without contamination of the fistulous tracts, and with greatly reduced danger of systemic infection following the internal urethrotomy.

3. Urethro-penile Fistulæ.—These are not as common as some of the other varieties. The fistulous tract is always straight and short, being rarely more than half an inch long. Sometimes it is so short that the urethral and integumental openings seem blended into one, the tissues being much thinned. They are almost always single, and have no diverticulæ. The internal orifice is frequently funnel-shaped; the external orifice is lined with a thin, smooth membrane. When the fistula is at

the level of the glans, and especially at that of the fossa navicularis, there have been seen a number of minute orifices instead of a single larger one. Indurations and callosities are not frequently met with. The size of these fistulæ is very variable; from those that will hardly admit a bristle to those measuring a half or three quarters of an inch in diameter.

Etiology is much the same as in the foregoing varieties. Both internal and external traumatism are frequent causes—simple and contused wounds. Infibulation, and the habit some ignorant women have of attempting to prevent their infants wetting the bed by tying up the penis, cause some cases. Strictures may cause penile as well as deeper fistulæ. Peri-urethral abscesses are common causes, and a number have been effected by phagedenic chancres and chaneroids.

Symptoms.—There are disturbances in micturition and ejaculation, both urine and spermatic fluid flowing wholly or in part by of the abnormal opening. If the fistula is so small that there is doubt as to its existence, compression of the glans at the moment of micturition will reveal the escape of the smallest amount of urine.

Diagnosis may be completed by conjoined urethral and external probing.

Prognosis is good. While these urethro-penile fistulæ are less dangerous than the deeper forms—in that there is much less liability to complications on the part of kidney and bladder—they are frequently obstinate. Some of the smallest resist all those means of treatment so long as only the trivial operations of stimulation and catheterization are resorted to.

Treatment.—As in the other forms of urethral fistulæ, if stricture be the cause or only a coexisting complication, the urethra must first be restored to its normal caliber; then, if the fistulous tract be a small one, its canterization by the electric loop, as described in considering the treatment of urethro-rectal fistula, will be most valuable. Uniform evacuation of the bladder at stated intervals must then be practiced for at least four days. If the fistula be large and short, after severing its infiltrated urethral margins and cutting any existing stricture on the urethral roof, the wire speculum should be introduced and opened so as to well expose the fistula. Then its edges can be freshened, either from the cutaneous or mucous side, or both, and if not resulting in too great an encroachment upon the urethral caliber, the freshened edges of the fistula may now be brought together by a separate linear row of sutures for both mucous and cutaneous surfaces—the presence of the wire speculum rendering it possible to work by sight within as well as without the urethra. In such a case regular catheterization may suffice, but a perineal urethrotomy will render success much more certain.

When the fistulous opening is too large to permit of closing by the operation of urethrorraphy as just described, some one of the various plastic operations must be resorted to.

4. **Urethroplasty.**—The chief forms of this operation are three :

1. By cutting and displacing the neighboring portions of skin.
2. Formation of a bridge of skin, by loosening of the subcutaneous connective tissue.

3. Formation of a skin flap from the nearest general integument, and transplanting it by two stages. The foreskin, scrotum, or loins may be used.

The best and most practical operations are as follows :

If the fistula is near the scrotum, the skin of that organ had better be used. A thick metallic catheter or the urethral speculum is passed, to fix and to make tense the urethral walls and the edges of the fistula. The ealloused edges of this latter are now so cut away that a quadrilateral opening remains (Figs. in Dittel, *Deutsche Chir.*, 49, p. 241 *et seq.*). The scrotal skin is now divided parallel to the posterior edge of the defect, and one to one and a half inch behind it. The bridge of skin loosened from the subcutaneous tissue, and its anterior borders united to the anterior borders of the defect. When union has taken place, the posterior margins of bridge and defect are freshened and united.

In the flap-transplantation operation the fistula is given the form of an elongated oval by freshening its edges. A flap of slightly larger dimensions is made of scrotal skin (Dittel, *loc. cit.*, p. 241). This is twisted or turned, as in the rhinoplastic operations, and united to the defect. After that has united, the base is adjusted and the posterior fistula is closed.

If the fistula is near the middle of the penis, a metal catheter or urethral speculum is introduced, and the edges of the defect are freshened. A bridge is then made, as described above, the skin being taken from where it is most available. The sutures can be removed in forty-eight hours. Periodic and careful catheterism or perineal urethrotomy is necessary.

In the operation by lateral sliding flaps, the edges of the fistula are freshened into an elongated oval ; then a suitable flap is made parallel to the side of the fistula ; only three sides are cut, and the attached flap is dissected up from its base ; then a narrower flap of the same length is entirely removed at the opposite side of the fistula, and the wounded surfaces adjusted by suture.

In the operation by longitudinal sliding flaps the defect is given the form of a transverse oval. A transverse bridge is made in the skin nearest the fistula ; on the other side of the defect a smaller denudation is made ; then the denuded portions are sutured, and when union is assured the posterior flap-wall and the posterior edge of the fistula are to be united in a similar fashion.

EXPLANATION OF FIGURES ON PLATE I.

Figs. 1, 2, 3, micro-organisms of the normal urethra. Fig. 1, *a* and *b*, bacilli resembling tubercle bacilli. Fig. 2, hyaline epithelial cell containing streptococcus. Fig. 3, epithelial cell containing pseudo-gonococcus. Fig. 4, pure culture of the latter on Agar. Fig. 5, gonococci from gonorrhœal pus : .1 : 1000 diameters.

PLATE I

FIG. 1.

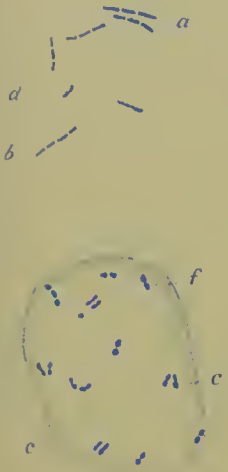


FIG. 2.



FIG. 5.

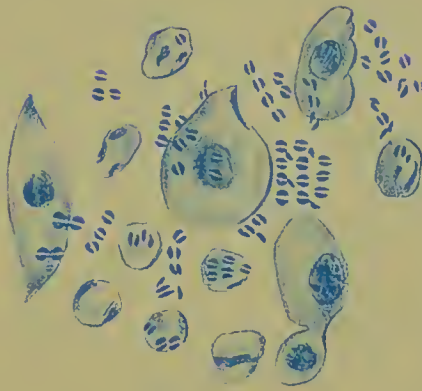


FIG. 3.

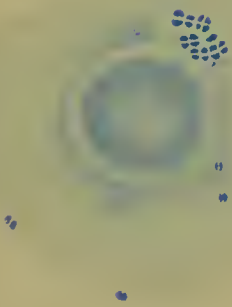
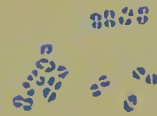


FIG. 4.



Normal microorganisms and gonococci of male urethra.

ETIOLOGY OF URETHRITIS.

By S. LUSTGARTEN, M. D.

WHEN we speak of urethritis, it is understood that a number of etiological factors may enter into its production. From a practical point, however, the gonorrhœal form is that which demands the closest consideration. In the present incomplete state of our knowledge we deem it best to divide the subject into the two chief classes—infectious and noninfectious urethritis.

A. INFECTIOUS URETHRITIS.

Gonorrhœa.—Without attempting to give a complete review of the history or even literature of the question, we have to remember that especially through Ricord's authority the fact has been established that gonorrhœa is a disease entirely distinct from syphilis—the "identists'" theory, which had so long held sway in consequence of Hunter's misinterpreted experiment upon himself, having been abandoned. Ricord's teachings brought about a controversy as to whether gonorrhœa is simply a catarrhal process or a specific disease possessing contagious properties. The adherents of the catarrhal view, the so-called "avirulists," claimed that only through its irritative action, and not through its contagious qualities, gonorrhœal pus reproduces the disease when brought into contact with healthy mucous membranes. In support of this belief, instances of gonorrhœa were cited which had developed in the male through contact with leucorrhœal and menstrual discharges, as well as after a variety of mechanical and irritative causes. This school found many followers in this country, which had given birth to its famous founder.

Ricord's opponents, on the other hand, maintained that a secretion of a mucous membrane which does not contain the contagion of gonorrhœa can never cause gonorrhœa. These men argued and proved that bougies covered with pus from abscesses and other sources, when introduced into the healthy urethra do not occasion a true gonorrhœa; and that cohabitation with women at the time of menstruation, or with those suffering from leucorrhœa or cancer of the uterus, do not of necessity bring about catarrh of the urethra; the distinction between catarrh and true gonorrhœa lying in the fact that the former has no period of incubation, is readily

and rapidly cured, and shows no tendency to attack adjacent organs. It is needless to say that the "virulists" steadily gained ground in the profession, and it was not long before diligent search began to be made for the specific cause of the disease. Various micro-organisms supposed to possess infectious qualities have been discovered by different observers, since, first in 1837, a harmless infusorium, *trichomonas vaginalis*, was accused, just as were Salisbury's threadlike germs, which he found in the pus of gonorrhœa, 1868.

Neisser, by his discovery of the gonococcus in 1879, finally put an end to many fruitless and often simply hypothetical discussions, and put a new phase upon the question more in keeping with modern scientific achievements.

The Gonococcus Neisser.—To discover the presence of the gonococcus, staining methods must be employed, and this is readily accomplished by means of the various aniline dyes. Then, with a high magnifying power, the relatively large micro-organism, measuring as it does from 0.8 to 1.6 micro-millimetres in length and 0.6 to 0.8 micro-millimetres in width, is seen either occupying the pus and epithelial cells, or lying free between these cells. The single coccus is kidney-shaped, or has somewhat the appearance of a coffee bean. They occur usually in pairs, lying close together, with their flattened surfaces looking toward each other. Multiplication takes place by each coccus splitting in two, so that groups form, which show in their grouping some resemblance to sarcina. These groups at times so completely fill up the pus-cells, that they seem to have occasioned a rupture, allowing the cocci to escape. After many unsuccessful attempts at cultivating the gonococcus, in which others had failed, Leistikow-Löffler, Krause, and finally Bumm, succeeded, the latter by employing serum of the blood of the human placenta as a culture medium. The cultures grow very slowly, and new culture-tubes must be inoculated quickly because of the tendency of the coccus to die in a few days. Bumm also was the first to give the final proof of the pathogenic rôle of these micro-organisms, by producing an acute gonorrhœal urethritis in a healthy female urethra by inoculation with first a second and subsequently a twentieth generation of the pure culture. Later on Von Schrötter and Winkler reported successful cultures on plover-egg albumen, although they did not carry out inoculation experiments. Aufuso has also succeeded in reproducing the disease from a twelfth generation of a culture made from the serum of a hydrarthrititis. Quite recently E. Wertheim found that gonococcus are easily cultivated and grow rapidly upon culture plates according to Koch's method, made with one part of human blood serum and one or two parts of peptone agar or gelatin solution. By this method the gonococcus grows so rapidly that within twenty-four hours the cocci show a very extensive develop-

ment, and form very fine transparent colonies. This observer materially strengthened the results of the preceding investigators in reproducing the disease with these pure cultures in five paralytic subjects. Wertheim's investigations have been confirmed by Gebhard.

The gonococcus has been found in the secretions of the various mucous membranes, which are now well known to be capable of taking on gonorrhœal infection, such as the urethra, vagina, uterus, conjunctiva, rectum, and even the mouth and nose in a few rare instances, besides, although not constantly, in Bartholinitis, pyosalpinx, periurethral abscess, periurethral folliculitis, as well as in joint affections. It has, however, yet to be determined by future investigations what percentage of the above-named complications, as well as of such others as Cowperitis, cystitis, pyelitis, prostatitis, buboes, perimetritis, etc., is due to the gonococcus alone or to other or mixed infections. Bumm, in his well-known work on the gonococcus, has made the assertion that only cylinder epithelium is a suitable medium for the invasion and development of the gonococcus; but more recent investigations have not substantiated this claim, since, for example, in paraurethral folliculitis the gonococci have been observed by Touton to penetrate the flat epithelium and invade the deeper strata of the tissue; and since Dinkler had claimed their penetrating qualities in ophthalmia gonorrhœica.

It is interesting and important from a medico-legal point that stains of gonorrhœal discharge on linen or underwear will permit the demonstration of gonococci even after several weeks, if the dried secretion is scraped off after being macerated and subjected to the staining process. This was first pointed out by Charles W. Allen in 1887, and quite recently confirmed by Kratter.

Staining Methods.—The gonococcus, as previously intimated, is readily stained with almost all basic aniline dyes, like fuchsine, methyl violet, gentian violet, methyl blue, Victoria blue, etc., and are with equal facility decolorized by alcohol, acids, or Gram's method. The latter has been claimed by Roux to be of practical importance for differentiation, since all other diplococci which resemble the gonococci retained the color when treated by the Gram method, while the gonococci lose it readily. The writer does not agree with these views, and will speak further on this question, so important and still so difficult of solution, in the following section.

An easy and quick way of staining is the following one: A small drop of pus or secretion * is spread in a very thin film on a cover-glass or slide

* In case too scanty a discharge is present, Neisser recommends an irritating injection either of sublimate 1 to 10,000 to 20,000, or nitrate of silver 1 to 2,000, which in the course of a few hours will set up a sufficient discharge.

with the aid of a platinum-wire loop. It is allowed to become dry on the air. The specimen is then passed three times, rather slowly, through the flame of an alcohol lamp or a Bunsen burner, with the right side turned upward. Then the preparation is covered with the staining fluid by means of a glass rod, and allowed to remain so for one or two minutes, after which time it is washed off with a jet of cold water, and examined either in water or, after carefully drying, in Xylol-Canada balsam. The staining fluid is better prepared fresh each time by adding to a watchglassful of distilled water with a pipette a small quantity of a concentrated alcoholic solution of methylene blue or Victoria blue, so as to obtain a dark-blue liquid.

Fig. 5 represents a preparation stained in this way with Victoria blue. It shows epithelial cells and lymphoid cells containing gonococci, as well as gonococci free in the field. The epithelial cells are here seen in such number as they are only found at the beginning and in the declining and chronic stage of the gonorrhœal process, while at the height of an acute attack the lymphoid cells being the almost exclusive forms present.

Gram's method, which may be used in dubious cases, is more complicated. To fresh aniline water (aniline oil, shaken well with water and filtered through a moistened filter-paper) a concentrated alcoholic solution of gentian violet is added, drop by drop, up to the point of saturation—i. e., until the liquid loses its transparency. The cover-glass, prepared as above, is allowed to float on this solution for ten minutes. It is then washed with water, and placed for five minutes in a solution of iodine 1 part, iodide of potassium 2 parts, distilled water 300 parts, and from there put in absolute alcohol, where it remains until no more color is extracted. After a renewed washing the preparation is subjected for half a minute to a second process of staining in a weak (light brown) watery solution of Bismarck-brown or vesuvin, washed again with water, and examined as before in water or Canada-balsam. If a preparation treated in this manner shows blue diplococci, one is sure that they are *not* gonococci; but in case of brown diplococci no absolute certainty is reached. For the bacterioscopic examination of gonorrhœal or urethral discharges a good microscope with Abbé's condenser and highly magnifying lenses is needed. Dry objective lenses are not to be recommended, except Zeiss's new apochromatic systems, while a one-twelfth-inch homogeneous immersion lens and an ocular No. 2 and No. 3 will answer the purpose very well.

Diagnostic Value of the Gonococcus.—The characteristics of a gonorrhœal discharge are (1) the presence of gonococci; (2) the habitat of these in lymphoid and epithelial cells; (3) their staining qualities, especially their becoming decolorized when subjected to Gram's method. These three points, which especially Neisser has emphasized and many

authors have accepted, no doubt hold good for every true gonorrhœal affection. The question now arises whether we are always entitled, when we find the stated conditions, to diagnose gonorrhœa a virulent and contagious disease, or whether not, under certain circumstances, harmless diplococci are apt to lead us astray. It hardly needs to be pointed out of what practical and forensic consequence this question is. Without wanting to go too much into details, our own researches (Lustgarten and Manna-berg, Vierteljahresschrift f. Derm. u. Syphilis, 1887), which have been confirmed in their essential particulars by Legrain, Poucy, and others, have shown that the *normal* male urethra is inhabited by a variety of micro-organisms, as Figs. 1, 2, 3 on Plate I show. Although most of these bacteria are harmless parasites, and will lead into error only a careless and inexperienced worker, still three of them deserve special attention, and these are (1) a pyogenic coccus, the staphylococcus aureus, whose presence explains to a certain extent the occurrence of acute inflammatory processes in and around the urethra without an infection from outside; (2) a bacillus which shares with the tubercle bacillus the morphological and the usually applied tinctorial qualities, Fig. 1, *a, b* (probably identical with the smegma bacillus), and whose frequent presence in the normal urine must be borne in mind to prevent a too hasty diagnosis of genito-urinary tuberculosis; and (3) one or several species of diplococci which resemble completely Neisser's gonococcus in shape and tinctorial qualities, especially in being decolorized by Gram's method. Only the last-named ones have any bearing upon the present question. They are furthermore found in epithelial cells (Fig. 3) and in *lymphoid cells*, which can not be distinguished from true pus-cells, although the latter can not of course be expected in the normal urethra. But as these "*pseudo-gonococci*" exist, they may, for instance, in a traumatic urethritis, be included by pus-cells, and thus simulate true gonorrhœa. (That would explain M. von Zeissl's observations in artificial urethritis.) We must, therefore, with all due respect to his great merits, contradict Neisser's assertions of the pathognomonic value of gonococci. Even a pupil of Neisser, Steinschneider, had to concede, in response to our publication, the possibility of error, which he estimates at five per cent, but which we would judge to be far higher without venturing to give any exact figures. Other careful observers, among whom are Fürbringer and Keyes, take also a reserved stand on this question. ❧

A distinction in principle between a gonorrhœic discharge and the secretion of the normal urethra (or certain nongonorrhœic discharges) seems to consist only in the fact that in the first cases the gonococci are to be found in larger number and in greater masses, and are not accompanied by so many banal micro-organisms.

But in an individual case, especially in that of a very chronic gleet,

the differentiation may be very difficult, and indeed almost impossible, for the decision of the question whether a gonorrhoeic and consequently contagious affection or a simple catarrh exists; and aside from the microscopical examination we may have to rely on the clinical features and our own clinical experience.

The same uncertainty applies to pus obtained from the vagina, since first Bumm and many others after him stated the normal presence there of several diplococci species resembling gonococci.

To sum up the well-established facts concerning the gonococcus according to the present state of knowledge, we arrive at the following conclusions:

1. The gonococcus Neisser produces gonorrhœa.

2. If an acute or purulent secretion contains gonococci with their characteristics, as described above, the affection is produced by gonococci. That does not of necessity apply to vaginal discharges of adults, as likewise reserve is indicated in the (often epidemic) vulvo-vaginitis in children, about the true gonorrhoeic character of which doubts still may be entertained.

3. If in a very chronic torpid urethritis with scanty, whitish, or grayish discharge,* diplococci with all the characteristics of gonococci are found, it does not prove that the affection is of gonorrhoeic nature and consequently contagious; especially not, if these diplococci are only to be found in comparatively small number and accompanied by a variety of other micro-organisms. This uncertainty is much to be regretted, as the question of the contagiousness of such cases turns up almost daily in the practice of the specialist and of the general practitioner as well, and as an absolutely reliable way of ascertaining the contagiousness would lessen considerably the professional responsibility. As far as personal experience goes, I am inclined to believe that many of the cases of (3) are indeed not contagious, and that the wives of such men remain healthy and prolific.

II. Pseudo-gonorrhœa.—Under this name Bockhart has described fourteen cases of urethritis, resembling in their symptoms an average gonorrhœa, for which he blames a very small diplococcus and an ovoid streptococcus. These micro-organisms could be cultivated and were inoculable in producing an acute urethritis. His statements have not been confirmed as yet. Under the name of pseudo-gonorrhœa we might as well in general include all kinds of infectious urethritis which can not be otherwise classified, as, for instance, one case reported by Neisser and one by Finger, probably produced by bacilli. To judge by the scanty re-

* Cases which, in the opinion of eminent clinicians, and in accordance with frequent experience, are no longer virulent.

ports, the cases belonging to this class must be very rare. It may be that we have to count among them the urethral discharges observed sometimes in acute febrile diseases, like typhoid fever, and which may be produced by the respective viruses of those diseases, in analogy with the exanthemata on the skin and other mucous membranes. Such occurrences, however, have a greater theoretical than practical interest and need further study.

III. Syphilitic Urethritis.—So have been called slight and indolent urethral discharges, seen by many observers (Bassereau, Bumstead, Taylor, etc.) during the secondary stage of syphilis, and which, no doubt, are the consequences of roscola or mucous patches in the urethra, as Grünfeld has demonstrated by endoscopic examination. Although of little consequence to the bearer, they deserve attention, as they may be the source of contagion, even when all externally visible symptoms of syphilis are wanting.

IV. Urethritis Tuberculosa.—Tuberculosis of the urethra, leading to tubercular ulceration, may in rare instances be a partial symptom of a more or less generalized uro-genital tuberculosis, or in even far rarer cases start primarily in the urethra. Primary lupus of the latter has, as far as I know, never been recorded. Quite recently Schuchardt reported a new and surprising form, the primary tubercular catarrh of the urethra and bladder, about which further communications have to be looked forward to before a decided opinion can be reached. In all these forms the clinical diagnosis will have to be corroborated by the demonstration of tubercle bacilli in the urethral discharge. Particular care has to be taken, and special methods have to be resorted to,* to carry this out in an irreproachable manner, and to prevent confusion with the smegma-bacilli, the common parasites of the normal urethra and urine.

B. NONINFECTIOUS URETHRITIS.

Urethral discharges, which we are at present justified in believing noninfectious, are observed under a variety of different etiological conditions. They are of comparatively little importance, and this in proportion to the causes from which they arise. These discharges have no period of incubation, and show a marked tendency to rapid cure if the cause is removed. For practical purposes it will suffice to simply enumerate, as causative factors, general conditions, traumatism, and chemical irritation. Under *general conditions* may be mentioned chronic bronchitis, chronic constipation, gout, oxyuris vermicularis, the excessive use of new beer and new cider, and possibly the presence of herpes in

* Boiling the preparation in a two-per-cent alcoholic solution of caustic potash before staining.

the urethra, etc.; under *traumatism*, the use of instruments, stone in the urethra, the introduction of foreign bodies, masturbation, excessive coitus, etc.; under *chemical*, the use of irritating injections, the internal administration of cantharides, and possibly the cohabitation with women during their menstrual period, and those suffering from leucorrhœa. Further investigations may show that the latter cases may be more properly ranged among the infectious forms.

ACUTE URETHRITIS.—GONORRHŒA.

By GEORGE EMERSON BREWER, M. D.

THE writer desires, at the outset, to enter a plea for the more general use of the etymologically correct term *urethritis*, as descriptive of the condition about to be considered, rather than the term *gonorrhœa*, which implies a pathological process known for more than two hundred years to be of incorrect application. Although it would be quite impossible to exclude from our vocabulary all the derivatives of this unfortunately incorrect term without creating confusion, still, in the pages that follow, use will be made as far as possible of terms which correspond to a more modern and a more correct nomenclature.

Definition.—An inflammation of the urethral mucous membrane, characterized by the presence of a purulent discharge and painful micturition.

History.—Regarding the history of this disease, it is only necessary to say that it is a disease of great antiquity, having been mentioned in the early medical writings of Hippocrates and Celsus. It was described with great accuracy by many writers during the middle ages, who distinctly recognized its symptoms and contagiousness. By these early observers it was generally regarded as a disease of the secretory apparatus, resulting in an abnormally large and more or less constant flow of semen from the external urethral orifice. Hence the name *gonorrhœa*.

Great confusion was created toward the end of the fifteenth century by the appearance throughout Europe of syphilis, chiefly from the fact of its being communicated, like urethritis, by sexual contact. For more than two hundred years these diseases were regarded by the majority of medical writers as due to one and the same virus. This view, however, was combated by Cockburn, Hales, Ellis, and many others. In 1767 John Hunter thought to establish the non-identity of the two diseases by inoculating himself with the pus derived from an individual during an attack of an acute urethritis. Unfortunately, however, the patient from whom the pus was secured was at the same time suffering from an unrecognized syphilis, and the resulting chancre and other manifestations of the latter disease which followed, retarded the further progress of knowledge upon this point for nearly half a century. The reaction from this

view began with the publication by Benjamin Bell, in 1793, of an exhaustive argument founded upon a large number of observations which seemed to disprove the theory adopted by the majority of authorities as a result of Hunter's experiment. His position was subsequently strengthened by the careful observations of Hernandez, published in 1811. The subject was finally cleared of its obscurity by the masterly thesis of Ricord, who demonstrated, from an analysis of over six hundred carefully observed cases, the non-identity of syphilis and gonorrhœa.

Varieties.—The urethra, in common with other organs and tissues of the body, may be the seat of several distinct varieties of inflammation. Until quite recently writers upon this subject contented themselves by describing only two forms of the disease. In view of modern investigation, and our increased knowledge regarding the causes of inflammation in general, this classification must be somewhat enlarged. Clinically, ever since the disease has been recognized, it has been observed that some cases present symptoms of great severity, while others pursue a comparatively mild course. The duration of the former is seldom under six or eight weeks, and often prolonged indefinitely even under the most careful treatment, while the latter frequently disappears spontaneously in a few days.

It has been for some time the generally accepted belief among the members of the medical profession that, in the severe cases, the inflammation is caused by contact with a specific virus contained in the purulent secretions from the diseased organs of a person similarly affected, but that the mild cases may arise from the irritating vaginal secretions occurring during menstruation or an attack of leucorrhœa; or they may be the result of an irritation of a sensitive point in a previously diseased urethra, caused by prolonged sexual excitement and the effects of alcohol. There are still other cases, though of very rare occurrence, where an attack of urethritis arises without contagion and in persons whose urethral mucous membrane has never been the seat of inflammatory disease. A certain number of these patients present in their urethræ characteristic lesions of tuberculosis, while others show, mainly by the effects of treatment, the inflammation to be the local manifestation of rheumatism or gout.

Urethritis may also be occasioned by traumatism and by the presence of lesions of syphilis, chancroid, and possibly herpes.

The question as to whether a perfectly healthy man by cohabiting with a perfectly healthy woman can by any amount of physical exertion, sexual excitement, or alcoholic stimulation, "give himself the clap," as Ricord expresses it, is far from being settled in the affirmative. Although I am aware that the great majority of writers upon this subject during the last half-century have declared that to be a fact, still, in the light of our increased knowledge regarding the behavior of gonorrhœal disease in

women, the question is still an open one. That a careful examination of the vagina and external genitals of woman fails to reveal the presence of disease, by no means proves that the subject of such examination is free from disease, for Noeggerath and many other authorities upon diseases of women have demonstrated that the cervix uteri, Fallopian tubes, and even the body of the womb itself, may be the seat of a grave gonorrhœal inflammation, without the slightest evidence being revealed by the most careful examination of the external genitals and vagina. Noeggerath goes so far as to say that nine tenths of all pelvic diseases peculiar to women may be traced to gonorrhœa.

It is a well-known fact also that the gonorrhœal infection in women almost invariably begins upon the mucous membrane of the urethra, and, indeed, may never spread to the vagina or cervix. The passage of urine just before an examination would in this case remove all evidence of disease, especially if the inflammation had passed the acute stage, leaving no tumefaction or redness of the urethral orifice to excite suspicion. Furthermore, in a chronic inflammation of the vulvo-vaginal glands, it is well known that a secretion can often be pressed out which is muco-purulent in character, containing gonococci in abundance. In view of these facts, and many others, the statement by Fournier that "a man gives himself the clap oftener than he receives it" must be accepted with a certain amount of reserve.

In this connection it may be stated, in further confirmation of this view, that during the years 1887 and 1888 the writer, while in charge of the genito-urinary room of the out-patient department of Roosevelt Hospital, had an opportunity of investigating a large number of these supposed cases of *strain*, or attacks of acute urethritis, acquired by individuals while cohabiting with presumably healthy females. In a considerable number of instances also in private practice an opportunity has been afforded of continuing these investigations. Although the number of such cases is not large, and the opportunities for thorough examination of both individuals afforded in only a small percentage of these, still, during the past six years twelve or fifteen such cases have been thoroughly investigated, with the result that in no instance have the acute inflammatory symptoms been accounted for in any manner other than by direct contagion, by contact with the gonococci-bearing secretions from the mucous membrane of some portion of the genito-urinary tract in the female, or by an exacerbation of an uncured urethritis in the male.

Etiology.—In 1879, Neisser, after a large number of observations, pointed out that the pus from the severer forms of urethritis and conjunctivitis differed from other varieties of pus by the presence in the former of a peculiar micro-organism which he called the gonococcus, and that in no other pus was this organism found. This statement has been

confirmed by a large number of observers since that time, so that to-day it may be safely stated that no one who has investigated the subject will undertake to deny the constant presence of this organism in these affections. Proof as to the exact etiological significance of this observation, however, was not furnished until several years after its discovery. This delay was due in a great measure to the difficulty in producing pure cultures of the organism, to the existence of large numbers of other organisms bearing a marked morphological resemblance to the gonococcus, and to the fact that inoculation experiments were necessarily applied only to the human urethra, animals, so far as is known, enjoying an immunity from this disease. As a result, however, of the carefully conducted experiments of Boekhart, Bokai, Bumm, Roux, and others, the gonococcus has finally been isolated, successfully cultivated, and the disease produced with all its characteristic symptoms by the inoculation of a pure culture, as far removed as the twentieth generation, upon healthy urethral mucous membrane. The relationship between the gonococcus and the severer urethral inflammations, therefore, seems to be established.

In an article published by Boekhart, in 1886, some interesting experiments are reported regarding the etiology of the non-specific, or, as he terms them, the *pseudo-gonorrhæal inflammations*. His observations are based upon fifteen cases of mild urethritis, in the secretions of which no gonococci were found. Investigation with other methods of coloring revealed the presence of two organisms differing wholly from the gonococcus, and from each other in staining reaction and appearance. These were also found in the vaginal secretions, alkaline in reaction, occurring in women as the result of menstruation, leucorrhœa, and cancerous disease of the cervix. The relation of these organisms to the milder forms of urethritis was subsequently rendered probable by successful culture, and inoculation experiments which resulted in the production, in healthy individuals, of a mild urethritis, corresponding in symptoms, course, and duration with the case from which the original culture was made. As in the writer's experience, in not more than one, or at most two, per cent of the cases of urethritis is it necessary to search for a cause other than the gonococcus to account for the symptoms, the term urethritis, when used in the following pages, unless otherwise defined, may be considered as referring to the usual form of the disease—that is, specific or gonorrhœal urethritis.

Infection.—The number of instances in which acute urethritis is acquired by means other than sexual intercourse is extremely small. Cases have been reported by Jullien, Horand, Winslow, and others, where the disease has been acquired and transmitted through the practice of unnatural sexual intercourse. Cases have undoubtedly been observed also where infection has taken place through mediate contagion, one such having

fallen under the writer's observation. Given the case of a healthy man who has sexual relations with a female whose genitals are contaminated by the secretions from a gonorrhoeal infection, and the chances are largely in favor of his acquiring the disease, in spite of the many precautionary measures which he may subsequently take. That he may occasionally escape, will not be questioned, and in this connection it might be advisable to consider briefly the conditions which favor infection and those which diminish its probability.

In his recently published work on this subject, Finger states that the development of gonococci is favored if the culture medium or tissue upon which they are deposited is alkaline in reaction. Ordinarily the mucous membrane of the urethra is bathed in a fluid the reaction of which is distinctly acid. Under conditions of strong sexual excitement, however, the glands and follicles of the urethra pour out an abundant alkaline secretion which neutralizes the previous acidity of the canal. Conditions, therefore, which heighten sexual excitement would tend to increase the probability of infection by insuring an abundant flow of alkaline mucus. In this manner may be explained the well-known effects of alcoholic stimulants, long-continued and frequently repeated sexual acts. A large urethral orifice is said also to favor infection by allowing easy ingress of the infecting material.

Regarding the conditions which diminish the probability of infection only two need be mentioned. The first and most important of these is immediate urination after the coitus; the second, prompt attention to cleanliness. The former, probably, acts more by restoring the acid reaction of the canal than by any mechanical removal of pathogenic organisms.

Incubation.—By this is understood the time which elapses between the contact of the virus and the first symptoms indicating an inflammatory reaction on the part of the mucous membrane. During this period the few pathogenic organisms which find their way into the urethral canal develop and multiply, until they are present in sufficient numbers to cause by their presence alone, or by fluids or gases elaborated in the process of their development, sufficient irritation to give rise to the reactionary symptoms which constitute the first evidences of the disease. The duration of this period is generally from one to fourteen days. Cases are occasionally encountered which exceed this latter limit. In the great majority of cases, however, the first symptoms are noticed on the third day; in at least two thirds of the cases, during the first week. The excessive use of alcohol, and long-continued erotic excitement, may shorten this period by supplying the conditions which favor a rapid development of the organisms. In cases of doubtful origin the observation of a distinct period of incubation is of value, as excluding those inflammations of the urethra due to the mechanical or chemical injury, as these have no

period of incubation, the reaction appearing almost immediately after the injury.

Clinical History.—About three days after exposure the patient experiences an itching sensation in and about the external urethral orifice. There is also a slight burning during and immediately after the passage of urine. The meatus is red, slightly swollen, and sensitive to the touch. An increased amount of mucus is present. These symptoms gradually increase in severity: the itching is replaced by a sense of heat and soreness; the lips of the external orifice become thickened, everted, œdematous, and highly congested; the pain, or *ardor urinæ*, is increased, and the mucous secretion becomes more abundant and assumes a distinctly purulent character. If the case is untreated, this progressive increase in the severity of the symptoms continues until the acme is reached. This is usually from the twelfth to the fifteenth day. The patient now presents all the characteristic appearances of an acute inflammation; the glans penis is intensely red, and often excoriated; the prepuce is œdematous; the whole organ hot, and sensitive to the touch, and in a constant state of partial erection. The discharge is very abundant, thick, creamy-yellow, or greenish in color. Each urination is accompanied by most excruciating pain; the stream is small, twisted, divided, or scattering, owing to a diminution in the calibre of the urethra from the swelling of the mucous membrane. At this stage there is, in nearly every instance, marked sexual irritability. Erections occur, chiefly at night, with great frequency, and are often prolonged for several hours. Owing to the inflamed and infiltrated condition of the mucous membrane its elasticity is greatly diminished, which prevents its partaking in the general expansion of the tissues during an erection. As a result of this, the organ becomes curved upon itself, the concavity looking downward. This alteration in the form of the organ during erection, or *chordee*, may vary greatly in extent, from a slight bending of the glans to a curve approximating a right angle. This condition frequently gives rise to great pain, often rendering the nights wholly sleepless. Seminal emissions at this period are of frequent occurrence, and add greatly to the general discomfort of the patient. Under unhygienic surroundings this condition may continue for many days and weeks with but slight, if any, abatement in the severity of the symptoms. Generally, however, improvement begins by the twentieth day, and the sufferings of the patient are gradually lessened, until there is no soreness, pain on micturition, *chordee*, or sexual disturbance. The discharge, however, may continue for some time after the acute inflammatory symptoms have disappeared. This, however, finally diminishes in quantity, becomes progressively less purulent and more mucous in character, and finally ceases, as it began, by a small, transparent drop.

The above description applies only to an uncomplicated case, where

the inflammation does not extend beyond the bulbo-membranous junction. The duration of such a case, if untreated, is extremely variable, probably never under four weeks; generally from eight to ten, and often for an indefinitely protracted period. Absolute rest, the avoidance of stimulating food and drinks, and freedom from sexual excitement, will often not only diminish greatly the severity of the symptoms, but shorten to a marked degree the duration of the disease. On the other hand, inordinate physical exertion, indulgence in alcoholic and venereal excesses, will often, in spite of the most careful treatment, prolong the disease indefinitely, increase the severity of individual symptoms, and render the patient liable to grave complications. If the inflammatory process extends beyond the compressor urethræ muscle, a number of complications, such as posterior urethritis, epididymitis, cystitis, prostatitis, etc., may occur, and greatly prolong the duration of the disease. These, however, will be considered in separate sections.

Pathology.—From the careful observations of Bumm and others, it is probable that the inflammatory process is occasioned and takes place after the following manner: A small amount of purulent material containing gonococci is deposited during the sexual act upon the mucous membrane of the fossa navicularis. These living organisms penetrate the epithelial covering of the mucous membrane, and, finding their way through and between the superficial cells, eventually reach the upper stratum of the sub-epithelial connective tissue. The irritation caused by this microbial invasion results in an acute hyperæmia of the part, with dilatation of the capillary vessels and exudation of serum. There is also an increased glandular secretion with epithelial exfoliation. Later, an abundant transudation of leucocytes takes place from the dilated capillary vessels. These, during their outward passage through the epithelial layer, absorb and carry with them large numbers of gonococci. If the urethra is examined at this time, the mucous membrane will be found to be thickened, deep red in color, and covered with an abundant muco-purulent or purulent secretion. The orifices of the mucous follicles appear as deeply injected, slightly elevated spots. Epithelial erosions and sometimes areas of genuine ulceration are present. The process begins in the fossa navicularis and gradually extends downward, reaching the bulbo-membranous junction about the twentieth day. When the wandering leucocytes have succeeded in removing the micro-organisms from the sub-epithelial tissue, and the gonococci-invaded epithelial cells have been washed away, the symptoms begin to subside. The hyperæmia diminishes, the sub-epithelial round-cell infiltration is absorbed, the erosions and ulcerations receive a new cellular covering, and the disease is at an end. Resolution takes place more slowly in the glands, which often continue to secrete pus long after the process has ceased in other portions of the mucous membrane.

Differential Diagnosis.—When the physician is called upon to assume the care of a patient who presents a discharge from the urethra, the first question to be decided is, whether or not the inflammation is of gonorrhœal origin. This can usually be determined by any one who is familiar with the use of the microscope. If the urethral discharge contains gonococci, we have to do with a case of true gonorrhœal urethritis. If, on the other hand, after thoroughly examining three or four slides, no gonococci are found, gonorrhœa may be excluded. Of the several conditions which may be mistaken for acute specific urethritis, the one which in its initial symptoms resembles it most closely is acute non-specific urethritis. In this instance we have to do with an inflammation of the urethra, due to contact with the irritating secretions of a simple leucorrhœa, menstrual fluid, cancerous disease, or pelvic abscess. The symptoms of this condition, which have been described by Boeckhart and Anbert, may vary from a slight irritation of the meatus, with an increased flow of mucus, to a urethritis, which, for a short time at least, may be compared in severity to an ordinary gonorrhœa. There is usually a distinct though variable period of incubation. The acme is reached in from two to six days, and the duration of the disease is seldom over twelve. The differential diagnosis can only be established by a microscopic examination of the secretion. A urethritis due to mechanical injury or chemical action may be differentiated by the absence of any period of incubation, by the sudden and often violent beginning and the equally rapid subsidence of the symptoms, and also by the history of the case, which, as a rule, clearly points to its origin. Chancroidal ulcers and the initial lesion of syphilis, when situated just within the meatus, may furnish a secretion which has been mistaken for urethritis. It is, however, hardly necessary to enumerate the differential points, as any one familiar with these conditions can scarcely fall into error if an ordinarily careful examination be made. A mucous or muco-purulent discharge from the urethra is occasionally present during the early secondary stage of syphilis, presumably due to the presence of mucous patches in the deeper portions of the canal. This may lead one into error in supposing that he is dealing with the first stage of a gonorrhœa. Observation for two or three days will, in most cases, suffice to establish the diagnosis. All of the above conditions are rare, and require but a passing notice.

The symptoms which most resemble an acute gonorrhœal infection are those due to an acute exacerbation of a chronic urethritis. It may be safely stated that, of all the cases of supposed acute urethritis that a physician is called upon to treat, in persons who have previously suffered from the disease, at least one half are cases not of a fresh infection, but of an awakening of an ancient and unhealed urethritis which may have been latent for many months, and even years. Except for the fact that

these cases show little or no period of incubation, and that the severity and duration of the acute symptoms are generally reduced, they differ in no way from the primary attack. From a therapeutic standpoint their difference is unimportant; from a social or medico-legal point of view, however, the decision of the physician may be of the greatest moment, especially when the honor of a member of the patient's family is at stake. The following facts should always be borne in mind in determining such a question:

First, that cessation of the discharge by no means indicates a complete recovery from the disease.

Second, that cases of chronic urethritis may exist where the inflammation is limited to one or more granular patches or small areas of chronic inflammation in the bulb or deeper portions of the urethra, the only evidence of disease remaining being the presence in the urine of small, thread-like bodies or *tripper faden*, regarding which mention will be made later.

Third, that the disease may remain latent in this manner for months and years, but under favoring conditions may again become active, and furnish a secretion which may contain gonococci in abundance.

Fourth, that this awakening of the latent disease may be occasioned by ill-health, the passage of urethral instruments, the excessive use of alcohol, and prolonged sexual indulgence.

Prognosis.—Among a certain class in the community this disease is regarded as an affection of but little or no importance; in fact, “no more to be dreaded than a cold in the head”; and, from the careless and indifferent manner with which it is treated by a large number of the medical profession, it would seem that this opinion regarding its innocuousness was not wholly confined to the laity. The quicker the spread of such ideas is checked, the better will it be for the reputation of the medical profession and for the welfare of mankind in general.

It is only under very exceptional circumstances that this disease threatens the life of the patient. Under unfavorable hygienic surroundings, and in subjects greatly reduced through dissipation and disease, the inflammation may become so acute as to result in local gangrene, septic infection, and death. A fatal termination not infrequently results from the immediate or remote effects of some of the complications of this disease, as acute suppurative prostatitis, purulent arthritis, stricture, and pyelo-nephritis. In general, however, the prognosis regarding life may be said to be good.

Regarding the probable duration of an uncomplicated case of acute urethritis modern authorities differ greatly. Ricord says, “Une chaude-pisse commence, Dieu le sait quand elle finira.” Keyes places the average duration at from four to six weeks. Prof. Otis was accustomed to tell

his class that no discharge which recovered under four weeks by any treatment was of gonorrhœal origin. These views were, however, somewhat modified during the last two years of his teaching. In a paper published in 1887, entitled *Some Observations upon the Modern Treatment of Urethritis*, the writer states, as a result of some experiments with bichloride of mercury, that "in uncomplicated cases of acute specific urethritis recovery may be expected within two weeks"; and during the five years which followed the publication of that paper, in a large number of cases, permanent *cessation of discharge* has been known to have taken place within fourteen days from the beginning of treatment. The following may be quoted from a paper on the subject, giving statistics from observations during five years upon the treatment of this disease with bichloride of mercury, which was read before the Genito-Urinary Section of the New York Academy of Medicine in June, 1891, and which will fairly represent the writer's present views upon the subject:

"These statistics I believe to be as conscientiously prepared and as accurate as any others gathered in the same manner from the same class of cases suffering from this disease, yet I believe them to be *absolutely worthless* from a scientific point of view, for even my comparatively limited experience in the treatment of urethral disease has taught me that the simple cessation of discharge by no means indicates a cure of the disease; and I am prepared to say, without the slightest hesitation, that it is my belief that, had a careful and thorough examination been made in each instance at the time when I reported the cessation of all discharge, not one case of my three series of cases would fail to show the unmistakable evidences of an uncured urethritis, which might under favoring conditions again become active and furnish a secretion which would be contagious.

"Regarding the length of time necessary to effect a complete and perfect cure by this or any other method of treatment, I must confess myself wholly unable to present a rule which would be even approximately correct, as in this disease, perhaps more than in any other, success depends upon so many conditions which are intimately associated with the temperament, personal habits, and general health of the patient."

Treatment.—Up to the present time the treatment of this disease has been mainly empirical. The reason for this probably lies in the fact that until quite recently but little was definitely known regarding its correct pathology.

As the investigations of Bumm and others have shown that the gonococci very quickly penetrate the epithelial covering of the mucous membrane, and collect in great numbers in the lymph-spaces of the upper connective-tissue layer, the logical conclusion is inevitable that the ideal scientific treatment must consist in measures which would insure the

presence in these lymph-spaces of a fluid containing an antiseptic agent capable of destroying these organisms, or at least of inhibiting their further development. This, for obvious reasons, could only be brought about by employing remedies which act through the circulating fluids of the economy, as substances present in the excreted urine, and those injected into the urethra, must necessarily fail to reach the deeply imbedded bacteria.

Clinical experience, however, has shown that certain antiseptic fluids, when injected into the urethra, do exert a marked action on the disease, both in subduing the acuteness of the symptoms and limiting its duration.

If our modern ideas regarding the pathology are correct, this can only be explained by the theory advanced by Halsted, which is that, although large numbers of gonococci undoubtedly do penetrate the tissues and become deeply imbedded in the connective tissue, the development of these organisms takes place at or near the surface of the mucous membrane, and consequently within reach of injected fluids.

In perhaps no other diseased condition have the resources of the pharmacopœia been so thoroughly tested as in the treatment of urethritis. As it would be a useless expenditure of time to enter into an exhaustive consideration of the many methods of treating this disease which have been suggested or employed in the past, only those procedures will be described which experience has proved to be of positive value. Before inaugurating any plan of treatment a few general directions should be laid down by the physician, the observance of which by the patient will greatly add to his comfort and the chances of ultimate success.

The use of alcohol should be absolutely prohibited. In the opinion of the writer, a large proportion of the cases which resist treatment may be accounted for by the fact that the physician is not sufficiently explicit in his directions in this regard. Even the moderate use of alcoholic drinks is deleterious. The only instances in which it should be allowed are in cases where from its long-continued use grave nervous disturbances would follow its sudden withdrawal.

Sexual excitement should be rigorously avoided, as the physiological congestion always present under this condition adds to the existing inflammation, and favors its extension to other portions of the genito-urinary tract.

Inordinate physical exertion must also be guarded against during the acute stage, as the hyperæmia induced by bodily exercise exerts the same untoward influence as that resulting from alcohol and sexual indulgence.

Rest in bed during the first four or five days of the inflammation, especially when combined with constant applications of hot water, affords the most effective means at our command of controlling the painful

symptoms of the disease and of diminishing its severity. In the great majority of cases, however, this is impracticable, and measures must be employed which will not necessitate absolute repose or confinement to the house. The pain which accompanies micturition, although probably due to a distention of the inflamed canal by the jet of urine rather than to the acidity of the fluid, as formerly supposed, seems to be modified often by diuretics and alkalies. The drinking of a large amount of pure water often fulfills this indication better than the employment of any other agent. Strong lemonade is more agreeable, and when taken in a sufficiently large amount will act as a diuretic and alkali, the citric acid, in common with all vegetable acids, being converted into alkaline carbonates in the economy. The relief of dysuria may often be afforded by immersing the penis in hot water during micturition. The injection also of a four-per-cent solution of cocaine into the urethra four or five minutes previous to urination will in most cases completely do away with the pain.

The Expectant Plan of Treatment.—The expectant plan of treatment, advocated by Fournier and other French surgeons, needs but a passing notice. Their plan is to defer all treatment, save hygienic, until the stage of decline, from four to six weeks from the beginning of the disease. As any acute inflammation of the urethra is liable to result in granular patches, local ulceration, and sub-epithelial deposits of lymph, which may, and generally do go on to the formation of stricture if allowed to remain unchecked for a month or six weeks, and as it is well known that the probability of all inflammatory complications is greatly increased by each day that the original source of infection remains unchecked, to adopt the French plan would seem to lay ourselves open to a charge of malpractice, especially as we have means at our control to arrest the inflammation, if not cure the disease in from two to four weeks.

Internal Treatment.—It has long been the hope of those interested in the treatment of urethral inflammations that some remedy would eventually be discovered which, when taken into the economy, would, either by its action through the blood or the urine, in destroying or at least inhibiting the irritating action of the pathogenic organisms, cure the disease. This hope has not up to the present time been fully realized.

Certain well-known drugs, as the alkaline diuretics, cubebs, copaiba, and sandal-wood oil, undoubtedly exert, when judiciously employed, a marked effect in subduing the painful and disagreeable symptoms of the disease, and occupy, therefore, a well-deserved place in the therapeutics of urethritis. That they limit the duration of the inflammation, has not been demonstrated; they should therefore be regarded as auxiliary measures, to be used when necessary in connection with such local applications as experience has shown to exert a positive influence in cutting short the

inflammation. The action of these remedies is doubtless through the agency of the urine rather than the blood; and the therapeutic effect is the result of contact of the urethral mucous membrane during micturition with the substances themselves or the products of their decomposition contained in the excreted urine. That this is true of *copaiba* at least, is evidenced by the experiments of Rieord and Roquette, who prescribed this agent to patients suffering from urethritis, and who at the same time had urethral fistulae. As a result of these experiments, it was found, during the internal administration of this drug, that that portion of the urethra behind the fistulous opening, through which no urine passed, remained unchanged. Subsequently, injections were made into the anterior portion of the canal of a portion of the urine passed by the patient while under the influence of the balsam; this produced the same amelioration of the inflammatory symptoms which was noticed in the posterior portion. Some years ago a number of experiments were undertaken by the writer at the outdoor department of one of our large hospitals to test the efficacy of the different drugs in the treatment of this disease. Several cases of acute specific urethritis were treated by each of these remedies, and compared with *control* experiments upon patients who received no treatment at all save some simple placebo. As a result of these observations, it was found that *simple diuretics* exerted apparently no influence either upon the severity of the symptoms or the duration of the disease; that *alkalies* in some instances seemed to lessen the pain during urination, but showed no tendency to diminish the discharge or otherwise modify the course of the disease. *Cubebs*, when given in sufficient doses (a teaspoonful of the powder every two hours), would often stop an abundant purulent discharge in from twenty-four to thirty-six hours, and so diminish the other painful symptoms as to render a previously suffering patient comparatively comfortable. The symptoms, however, would reappear in proportion to the degree to which the dose was diminished; and when discontinued entirely, even after several weeks' use, the disease would still appear and pursue much the same course as if untreated from the first. The continued use of this drug in large doses would frequently produce grave gastric disturbance, necessitating its withdrawal. *Copaiba* was found to be less useful than *eubebs*, chiefly for the reason that it produced more general digestive disturbance. When borne in large doses its action was practically the same as that of *eubebs*. Complete anorexia, severe vomiting, diarrhoea, and cutaneous erythemata were the common accompaniments of its exhibition. *Sandal-wood oil* was slightly less efficacious than the other two drugs, but had the marked advantage that it created much less gastric irritation. It was the only agent that could be used in sufficient doses to markedly modify the symp-

toms for a sufficient length of time to be of any practical value. Epigastric and lumbar pain, with anorexia and vomiting, may occasionally occur as a result of its use, and, rarely, a macular erythema. The following *résumé* of the agents employed, their preparation and doses, may be of value :

Pure water taken in quantities of from two to four quarts a day proved most useful as a diuretic agent. Potassium acetate, when given in doses of fifteen to thirty grains three or four times a day, largely diluted, acted as a reliable diuretic. If the dose was so increased that the patient absorbed from one to two ounces of the salt in twenty-four hours, the effect was to render the urine alkaline in reaction. Potassium citrate produced much the same result, but had to be given in somewhat larger doses. Sodium bicarbonate acted as a reliable alkali, in doses of twenty or thirty grains, frequently repeated. The most satisfactory preparation of cubebs was the freshly made powder; of copaiba, the oleo-resin in capsules of ten minims each. Of the sandal-wood oil preparations, the one found most useful was the "Santal midy capsule" made by Fougere & Co., Paris; these should be given in doses of two to four capsules after each meal.

The following prescription, known in hospitals and dispensaries as the "Lafayette mixture," is found to be useful:

R Copaibæ.....	℥j.
Liq. potassii.....	℥ij.
Ext. glycyrrhizæ.....	℥ss.
Spt. ætheris comp.....	℥j.
Syr. acaciæ.....	℥iv.
Ol. Gaulth.....	℥xx. M.
Sig. ℥ss. t. i. d.	

Several other drugs closely allied to the balsams above described have been advised and more or less extensively used in the treatment of this disease. Among these may be mentioned *gurjun balsam*, which was brought to the notice of the profession by Vidal in 1877. This drug is similar in action to copaiba, and is said to possess the advantage of exciting much less nausea and digestive disturbance. The dose is from one half to one drachm daily, preferably taken in mucilage of acacia or some sirupy fluid.

Kava-kava was at one time used to a considerable extent as a substitute for cubebs. It is employed in the form of an infusion, or in pills made from the extract, the dose of the latter being one to two grains three or four times a day.

Oil of turpentine undoubtedly exerts a marked effect upon inflammations of the mucous membrane of the urinary passages, but its exhibition is attended with such marked discomfort to the patient that its use has been practically abandoned.

Local Treatment.—The local treatment of this disease has engaged the attention of medical men for a considerable period, and has been steadily growing in favor.

When one considers the fact that urethritis is a purely local disease, limited during the first few days at least to the anterior portion of the urethral mucons membrane, it is not surprising that many have entertained the hope, and with a considerable degree of reason, that some local procedure should be found which would arrest the inflammatory process and destroy the poison which produced it. In no other local inflammatory condition have efforts proved so uniformly unsuccessful. The reason of this possibly lies in the fact, which has previously been mentioned, that the micro-organisms have already developed to a large extent, penetrated the epithelial layer, and formed colonies in the lymph-spaces and connective-tissue layers of the mucons membrane long before the inflammatory reaction has made its appearance, and that any local measures which do not entirely destroy the mucous membrane itself fail to exert their influence upon the deeper-seated organisms.

Several so-called abortive methods have been suggested, and employed with varying degrees of success. These will be considered first.

Nitrate of Silver.—The injection of a strong solution of nitrate of silver (ten to thirty grains to the ounce) into the urethra immediately upon the first appearance of the symptoms of this disease, has been practiced by many eminent genito-urinary surgeons and with a certain degree of success. The great pain caused by its employment, however, and the uncertainty of result, combined with the wide prevalence of erroneous ideas regarding its probable causative influence in the production of stricture and other grave complications, have led to its practical abandonment by most surgeons. Quite recently an article has appeared in the London Lancet by Mr. C. E. Cotes, describing a method of employing nitrate of silver, which has proved in his hands most successful. The anterior urethra is thoroughly cleansed of all pus by urination, and subsequent swabbing with cotton by means of the endoscope. A solution of nitrate of silver, ten grains to the ounce, is then applied through the endoscopic tube to the entire anterior portion of the urethra by means of a cotton applicator. An extra amount of this fluid is employed upon the anterior third of the canal. The patient is then instructed to remain in bed for from forty-eight to seventy-two hours. The intense inflammatory reaction which follows this application subsides in three or four days, and no further treatment is required. The author reports forty cases successfully treated by this method, and if equally happy results can be secured by others the treatment of this disease will be relieved of many of its embarrassments.

Guiteras's Method.—In a paper read before the Genito-Urinary Section

of the New York Academy of Medicine in June, 1892, Dr. Ramon Guiteras suggests a new method of treatment by the use of solutions of nitrate of silver. His plan is to make one injection, every second day, of a solution of nitrate of silver, beginning with the strength of two grains to the ounce, and increasing by two grains at each application, until the strength of twenty grains is reached. In the interval which elapses between the treatments the patient simply keeps the urethra thoroughly washed out with a mild solution of zinc acetate, boric acid, or peroxide of hydrogen. He reported several cases of apparent cure in from two to fourteen days.

Dr. F. Tilden Brown has also reported a case which yielded to this method in five days. The plan promises well, but has not as yet had a sufficient trial to demonstrate its real value.

Thiéry's Method.—In an article upon the treatment of urethritis, by Dr. Paul Thiéry, which appeared in *Le Progrès Médical*, March 3, 1887, attention is called to a method of employing iodoform in the urethra, by which he succeeded in aborting six cases in from five to twenty-five days. His method was by the simple injection of a mixture of iodoform powder in sweet almond-oil or glycerin. This application was made once daily, after urination, and the fluid retained in the canal for fifteen or twenty minutes. These injections, it is claimed, produce little or no immediate discomfort to the patient, and relieve to a marked degree the acutely painful symptoms of the active stage of the disease.

Several other agents have been employed with a view to aborting the disease, among which may be mentioned bichloride of mercury, permanganate of potassium, and peroxide of hydrogen; and although experience has not shown that any agent at present at our command has the power in all cases to abort the inflammatory process, it is not unreasonable to hope that such an agent may be discovered in the future. Certain it is that several remedies are known to have the power to markedly modify, diminish, and prevent the extension of the inflammation, limiting thereby to a considerable degree the duration of the disease and producing a marked amelioration in the disagreeable symptoms.

Space will not permit even a partial review of the many drugs which have been employed in the local treatment of this disease. Moreover, such an enumeration would be unprofitable, as in nearly every instance previous to 1887, when reported cures were published by this or that agent, no attempt was made to distinguish between a genuine fresh infection of an acute urethritis and the other less troublesome forms of the disease; and brilliant results have frequently been reported with drugs and chemical agents which are known to all familiar with the subject to be practically inert in the acute and severer forms of the disease.

Heat and Cold.—These agents have been used with marked effect, the former for the hyperæmia and œdema so often present in the early stage, the latter in controlling the erections and ehordee, which render the nights so much to be dreaded. Hot sitz-baths frequently repeated, soaking the penis in a cup of hot water, and the more or less constant application of hot fomentations, will be found of the greatest value. The sexual hyperæsthesia is best controlled by the cold-water coil of Otis or by the employment of an ice-bag to the perinæum.

The application of heat directly to the urethral mucous membrane by means of the retrojection of hot water was first brought to the notice of the profession by its inventor, Dr. H. Holbrook Curtis. His apparatus consists of a tin pail, beneath which is fastened a platform for an alcohol-lamp or Bunsen burner (Fig. 1). The pail is connected by means of a long rubber tube with a No. 18 F. soft-rubber catheter. The whole is suspended from the ceiling by means of a cord or pulley, and can be raised or lowered at will. The patient, after having first passed his water, is seated on the edge of a chair, over a large-sized slop-jar or pail. The catheter, well oiled, is passed carefully into the urethra about five inches, and the current of water started. This is at first about the temperature of the body, but is gradually raised until it is as hot as the

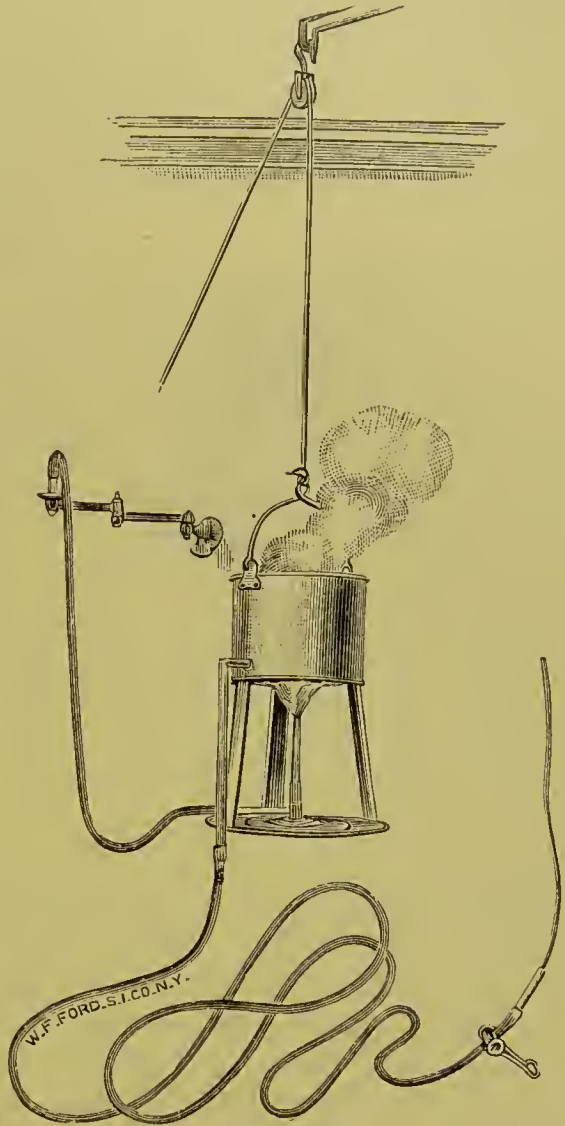


FIG. 8.

patient can bear. About two quarts are passed through the urethra at each sitting. This should be repeated two or three times each day. This insures thorough irrigation of the canal and the prolonged action of heat upon the mucous membrane. As the result of this method of treatment, the patient experiences at once marked relief from the pain and other inflammatory symptoms. Unless, however, the fluid employed con-

tains some astringent or antiseptic agent, the effect on the discharge or the ultimate duration of the disease is not marked.

In hot retrojection, however, we have perhaps the best method of applying medicated solutions to the urethral mucous membrane. The advantages are that it thoroughly cleanses the canal, and brings the fluid in contact with every portion of the mucous membrane (a result rarely accomplished by any other procedure). It produces but slight irritation, and is followed by a feeling of comfort to the patient.

The other methods of local application are by the Halsted plan of continuous irrigation, by simple injection, and by the use of ointments and soluble bougies. The method of continuous irrigation was first suggested by Dr. W. S. Halsted, and is as follows: An elevated reservoir

containing the fluid is connected by means of a rubber tube with a glass or gutta-percha nozzle (Figs. 2 and 3). The patient is instructed to pass his urine, and then, standing in front of a sink or basin, the nozzle of the irrigator is firmly pressed against the urethral orifice. The current is so di-

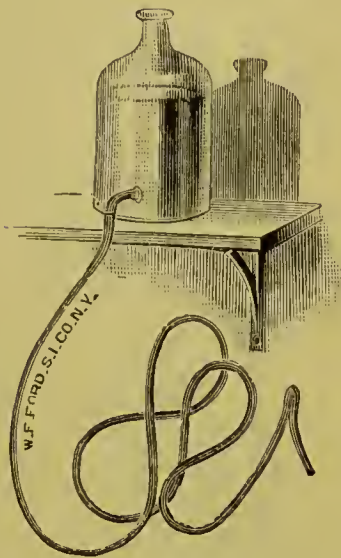


FIG. 2.



FIG. 3.

rected that the stream of fluid enters in the line of the canal, and not obliquely against the urethral walls. When this is accomplished, all that portion of the urethra anterior to the bulbo-membranous junction can be felt to be completely distended or "ballooned out." Sufficient outflow is now permitted to keep the fluid in motion while the urethra remains distended. From one to two quarts of fluid should be allowed to pass through the urethra at each irrigation. The ordinary method of applying astringents or antiseptic agents to the urethra is by means of solutions injected into the canal. To properly inject the anterior urethra, two things are necessary—a suitable syringe, and a certain amount of dexterity on the part of the patient. Regarding the former, an ordinary glass or hard-rubber syringe having a conical nozzle, an even barrel, and well-fitting piston, should be chosen. The capacity should be from two to three drachms only. The most satisfactory instrument of this

kind is one having a hard-rubber barrel and soft-rubber tip. The patient should always urinate just before injecting, to clear the canal of pus. The nozzle of the syringe should then be introduced within the meatus as far as it will go, and the lips firmly pressed with the thumb and forefinger, laterally against its nozzle. The direction should be in the axis of the canal, and the fluid slowly introduced by pressure on the piston. If this is properly done, not one drop of fluid will escape until the canal is completely distended. The syringe should then be removed and the lips of the meatus compressed. The fluid should be retained for at least one minute and then allowed to escape.

The plan of introducing medicated ointments into the urethra was employed during some experiments by Dr. Halsted several years ago, but without demonstrating any advantage.

Soluble bougies have been extensively used by some surgeons in the treatment of this disease. In the writer's experience, however, the irritation produced by their presence so frequently resulted in posterior urethritis and other complications that they were discarded.

In the choice of methods of making local applications to the urethra, the physician must necessarily be governed by circumstances. If possible, one of the irrigating methods should be employed. Equally good results are often effected, however, by the judicious use of the syringe in patients capable of appreciating and carrying out the instructions regarding its proper use. A large number of individuals, especially in dispensary practice, seem incapable of acquiring sufficient skill in the use of this instrument to insure contact of the fluid with the entire anterior urethra. No patient should be given a syringe to use until he has demonstrated, in the presence of his medical adviser, his ability to distend the canal properly.

Alkalies.—The local use of solutions of bicarbonate of sodium and other alkalies has been advocated by a number of distinguished surgeons. Theoretically, the local use of alkalies would favor rather than retard the inflammatory process, and a number of experiments by the writer with these agents show that they at least exert no favorable influence on the disease.

Astringents.—Regarding the use of simple astringents, it may be said that whereas experience has shown them to be of practically no value in the acute stage of a specific urethritis, their employment in the declining stage is attended often by the most happy results. In this condition the mineral astringents will be found to be of greater value than the vegetable agents. Of these, the acetate of zinc is probably the best. A solution of this should be injected from four to six times daily, in strength varying from two to twelve grains to the ounce. A milder solution should be used at first, the strength being increased as the discharge becomes more watery.

Several other salts enjoy the reputation of being equally efficient, such as the sulphate and the sulpho-carbolate of zinc, the chloride of zinc, alum, acetate of lead, and the permanganate of potassium. The addition of an aqueous preparation of opium or tannin to the astringent solution seems often to exert a salutary influence. The following prescriptions have been quite extensively used :

℞ Zinci sulphatis,
Plumbi acetatis.....āā gr. xxx.
Aquæ rosæ..... ℥ vj. M. (Ricord.)

℞ Zinci sulphatis..... gr. xv.
Plumbi acetatis..... gr. xxx.
Ext. krameriæ fl.,
Tinct. opii.....āā ℥ iiij.
Aquæ.....ad ℥ vj. M. (Taylor.)

℞ Ext. hydrastis fl..... ℥ j.
Aquæ.....ad ℥ vj. M.

A consideration of the use of these drugs in detail belongs rather to the chapter on chronic urethritis than in this connection.

Bichloride of Mercury.—The systematic use of bichloride of mercury in the treatment of urethritis was not undertaken until the original experiments of Halsted at the Roosevelt Hospital in 1884. He found that the local employment of a large amount of a very dilute solution of this agent proved far more useful than that of a small amount of a more concentrated solution. His method consisted in thoroughly irrigating the urethral canal by means of his irrigator, described above, with a solution of bichloride varying in strength from 1 to 100,000 to 1 to 10,000. This was done twice daily, the patient receiving no other treatment. The results of these experiments of Halsted were reported by Dr. S. O. Vanderpoel in the Medical Record for March 27, 1886. He cites the histories of six patients, all with undoubted attacks of acute specific urethritis, cured in from ten to fourteen days. The success which attended the use of this agent seemed so far in advance of that following any procedure previously employed, that experiments were at once undertaken by a number of observers with a view of determining the accuracy of Halsted's observations. During a series of experiments by the writer, a thorough trial was made of bichloride of mercury, by the method of irrigation suggested by Halsted, by the Holbrook-Curtis method of hot retrojection, and by the use of the simple piston syringe. Over three hundred cases of acute specific urethritis were treated, and the results carefully recorded. In a paper read before the Genito-Urinary Section of the New York Academy of Medicine, in June, 1891, these results are analyzed, and statistics given regarding the length of

time necessary to effect a cessation of the discharge, and also regarding the frequency of complications. At the close of that paper it was stated that it was the writer's firm belief that "the judicious use of bichloride of mercury in cases of acute gonorrhoeal urethritis is attended with better results in subduing the painful and disagreeable features of the disease than that of any other agent; that recovery is more rapid and permanent, and that the frequency of inflammatory complications is greatly reduced."

In the preceding pages an effort has been made to describe briefly the methods of treatment which the most recent experience of those interested in the subject has shown to be of the greatest value, and which, therefore, are at the present time most generally employed. In estimating the comparative value of the different methods, the writer has been guided by personally conducted experiments rather than by the opinions of others.

As a result of these observations, the following plan has been found to be most useful in the majority of cases:

As soon as a patient with an uncomplicated attack of acute specific urethritis presents himself for treatment, he is given a cathartic, and instructed to religiously abstain from alcoholic drinks, highly seasoned food, sexual excitement, and excessive bodily exercise. If the disease is in its initial stage, and the inflammatory symptoms still unimportant, a hot retrojection of bichloride of mercury (1 to 30,000) is employed twice daily. If this plan is impracticable, he is instructed in the proper use of the syringe, and advised to use the same solution twice daily, taking ten injections in the morning and ten at night, to imitate as nearly as possible the method of continuous irrigation. If the inflammatory symptoms are severe, and the bichloride causes marked pain, the local treatment is suspended for two or three days, and oil of sandal-wood given in full doses. When the inflammatory symptoms have sufficiently subsided, the bichloride is again resumed. Under this treatment the painful symptoms rapidly disappear, the secretion undergoes a change from an abundant, thick, purulent discharge to a thin, watery fluid. This is daily examined for gonococci, and when these are absent, or when the discharge has been watery for three or four days, the bichloride is suspended, and a soothing injection of sulpho-carbolate of zinc, or preferably bismuth suspended in glycerin and water, is employed. This should be given at first after each urination, and the frequency then gradually reduced until it is taken only at bedtime. In uncomplicated cases, where these directions are successfully carried out, the discharge generally ceases in from six to twelve days. The bismuth, however, should be continued once or twice daily for two or three weeks, as its suspension is likely to be followed by a return of the discharge. Any indiscretion, or departure from the hygienic regulations during this treatment, is also likely to again light up

the inflammation. After the discharge has ceased, it may be necessary to employ sounds, local application of nitrate of silver by means of the endoscope, and general tonic medication, to complete the cure; for, although the patient may have no visible discharge, and suffers no inconvenience, the disease is still far from well. The two-glass urine test (to be described later, in the chapter on posterior urethritis) should frequently be employed, and a microscopic examination made of the *tripper faden*. As long as these contain gonococci, or sink to the bottom of the glass, as they invariably do when made up largely of pus, the patient should remain under observation. He can be pronounced well, and not likely to experience a return of the symptoms, only when—

1. There is no visible discharge.
2. When the *tripper faden* are absent, or rise to the surface of the fluid, and contain no gonococci; and—
3. When neither stricture nor prostatitis exists.

COMPLICATIONS OF URETHRITIS.

Posterior Urethritis.—Of all the complications which arise in a case of acute gonorrhœa, posterior urethritis is by far the most frequent, occurring, according to different authorities, in from sixteen to eighty per cent of all cases. By posterior urethritis is understood an extension of the inflammatory process to that portion of the urethral mucous membrane between the bulbo-membranous junction and the bladder. Under ordinary circumstances, in a simple case of acute urethritis, the disease confines itself to the anterior urethra. The reason of this is, not, as has been generally supposed, that the compressor urethræ muscle offers a mechanical barrier to its progress, but rather that the membranous urethra, by being much less vascular than the other portions of the canal, and almost devoid of glands and follicles, offers a much less favorable soil for the development of pathogenic organisms, and in that way acts as an effective bar to its further progress. This extension, however, may be favored by many factors, such as a diminished power of resistance on the part of the tissues as a result of tuberculosis, syphilis, or other debilitating diseases, or a favoring congestion of the parts due to inordinate physical exertion, the abuse of alcohol, and sexual excitement. It may also be produced by direct infection as the result of the passage of urethral instruments. Unless caused in this manner, it rarely appears before the end of the third week; but may occur at any time after this period. This extension of the inflammation to the posterior urethra is important, not only on account of the painful symptoms to which it may give rise, but also on account of the fact that, by greatly increasing the extent of the disease, it renders complete recovery much more uncertain and remote; and by its proximity to other important organs greatly enhances the

probability of a further extension of the inflammation to the bladder, seminal vesicles, and testicles.

Symptoms.—This complication may occur with no appreciable subjective symptoms. Generally, however, there is a sense of heat, heaviness, and discomfort in the perineal region, with an increased frequency of urination. If the inflammation is more acute, the calls to urinate may occur every few minutes, and are accompanied by great urgency and painful bladder tenesmus, with radiating pains and free hæmorrhage at the close of the act. In a particularly severe case under the writer's observation, the urine was passed by involuntary spasmodic effort every two or three minutes, accompanied by the most excruciating pain and marked hæmorrhage. A membranous cast of the prostatic urethra and several smaller croupous shreds were passed during the height of the inflammation. Abnormalities on the part of the sexual function are of frequent occurrence in this condition, especially when the inflammation involves the *caput gallinæ*. There is heightened reflex sexual irritability, as evidenced by frequent and prolonged erections, especially at night, accompanied often by involuntary seminal emissions.

Physical Signs.—Rectal examination reveals, in some instances, marked tenderness over the membranous and prostatic urethra, without enlargement of the gland. The only strictly reliable information regarding the presence or absence of a posterior urethritis, however, is to be gained by the careful employment of the two-glass urine test. This test is based upon the fact that the pus resulting from an inflammation of the mucous membrane of the anterior urethra makes its escape by flowing outward through the meatus, progress in the opposite direction being prevented by the action of the compressor urethræ muscle. On the other hand, pus generated in that portion of the urethra behind the cut-off muscle flows backward into the bladder. If, therefore, the patient passes his urine in two glasses, that containing the first portion passed represents a sample of the urine collected in the bladder, plus the washings from the urethra; the second portion, on the other hand, represents only that contained in the bladder unmixed with urethral pus. In the absence of suppurative disease of the bladder or kidneys, pus in the second glass always means a posterior urethritis.

In this connection several facts may be mentioned which will be of value in determining the amount of inflammatory disturbance present. In mild inflammations of the posterior urethra, when but little pus is secreted, if the urine be passed frequently, that in the second glass may remain clear; if, however, an examination be made after a long retention, or in the morning immediately after a night's sleep, the second glass will always show the presence of pus. This occasional presence of a clear specimen (after short retention) is of value in excluding cystitis.

Treatment.—In mild cases, where the posterior urethritis is evidenced only by an examination of the urine, no subjective symptoms being present, the only indication for treatment is to increase the outward flow of urine, and render it sterile by the internal use of borie acid or salol in doses of five to ten grains of each four or five times a day. The best diuretic for such cases is the daily consumption of from two to four quarts of plain water. If slight frequency and tenesmus exist, the patient should abstain



FIG. 4.

from active exercise and remain quietly at home. He should take, in addition to the diuretic agent, small doses of opium or hyoscyamus to control the urgent symptoms. In the severer cases absolute rest in bed must be enforced. Diuretics, and opium in the form of suppositories, should be given until the pain and frequency of the urination have been controlled. In addition to these palliative measures, an application of nitrate of silver should be made direct to the inflamed area every second or third day. For this a solution of from five to ten grains to the ounce of water should be employed. This should be deposited on the inflamed area by an Ultzmann deep urethral syringe (Fig. 4), or, better still, Keyes's modification of Ultzmann's instrument (Fig. 5). The method of procedure is as follows:

The patient should lie upon his back in bed or on a table. The anterior urethra should be washed out, to remove irritating secretions. The



FIG. 5.

syringe should be carefully introduced, until the point of the beak lies just behind the compressor urethræ muscle and within the prostatic urethra; that, in ordinary cases, is when the shaft of the barrel is at an angle of 45° with the horizon. To facilitate its introduction, the barrel should be anointed with a small amount of glycerin, as oily substances protect the mucous membrane from the action of the fluid. From five to ten minims of the fluid should be slowly injected. Before removing

the syringe, especially where concentrated solutions are employed, it is well to withdraw slightly the piston, which prevents the dripping of the solution while the syringe is being removed. In this way the fluid is prevented from leaking into the anterior urethra. The object of making this application before the patient empties his bladder is, that the action of the nitrate of silver can be quickly neutralized by the passage of urine if it prove too irritating. The results which follow the judicious use of this agent are often strikingly prompt and satisfactory. There is usually at first an increased amount of pain and tenesmus. This should be controlled by local applications of heat and the use of opium, or morphine suppositories. In from six to twenty-four hours after the application there is generally experienced a marked relief from the distressing symptoms. As a general rule, the second injection should not be made until the irritation produced by the first has fully subsided. The strength of the solution should be increased at each application by from two to five grains to the ounce. The relief is usually more prompt in the severer cases. It is a recognized fact that cases of posterior urethritis yield to treatment much more readily if attacked at once, whereas, if allowed to continue until subacute or chronic, they become often the most obstinate and discouraging of patients. The reason for this lies in the fact that the prostatic urethra is so richly supplied with glands and follicles, each of which, with its surrounding network of capillaries, forms a miniature incubator for the development of gonococci. When the disease is allowed sufficient time to penetrate these, it is to a great extent beyond the reach of local treatment, and proves often most rebellious.

In dealing with a case of posterior urethritis, it should be borne in mind that a further extension of the inflammation usually results from the slightest exciting cause. Special emphasis should therefore be placed upon all directions regarding the maintenance of absolute rest, and the avoidance of stimulants and sexual excitement.

Epididymitis.—This complication comes next in point of frequency. Statistics vary largely regarding its occurrence, depending presumably upon the class of cases observed and the amount of care employed in their treatment. Gouley states that it occurs in about thirty per cent of all cases of acute urethritis. The majority of modern authorities, however, place it at about sixteen per cent. In three hundred and two acute cases treated by the writer with bichloride of mercury, epididymitis occurred in but six instances, or about two per cent of the patients. In three hundred and fifty-two cases treated by other methods, this complication appeared in sixteen per cent. As in the case of cystitis and prostatitis the presence of a posterior urethritis enhances greatly the probability of its occurrence. In fact, it may be seriously questioned if this complication

ever occurs without a previous extension of the inflammatory process to the posterior urethra.

The infection may take place directly by an extension of the inflammation along the mucous membrane of the ejaculatory ducts, seminal vesicles, and vasa deferentia, or indirectly through the lymphatics. In the former instance we have involvement of the spermatic cord, preceding by several hours or days the inflammation of the epididymis. In the latter the symptoms are first noticed in the epididymis, and indeed may remain wholly limited to that locality.

This complication occurs with most frequency in the third and fourth week of the disease, rarely before the fourteenth day, but after that period it may occur at any time while the urethritis is present. The predisposing cause of the epididymitis is a posterior urethritis. The prophylactic treatment consists in the employment of measures calculated to shorten the duration of the original inflammation and prevent its extension to the posterior urethra, strict adherence to hygienic regulations mentioned in the chapter on treatment, and the wearing of a well-made suspensory bandage.

Symptoms.—The inflammation may be ushered in by a chill, followed by a high fever. This is usually accompanied by a more or less severe pain in the region of the testicle. Exceptionally, the pain is at first noticed in the region of the inguinal canal and upper part of the spermatic cord. In these cases the cord can be felt to be considerably enlarged, hot, and tender, before any change can be felt in the tissues of the epididymis. The swelling of the affected parts takes place rapidly, and frequently within a few hours from the first symptom, the affected half of the scrotum will be enlarged to twice or three times its normal size, very hot, and exquisitely tender. Examination reveals the presence of a large, indurated mass nearly surrounding the testicle, composed of the infiltrated tissues of the epididymis. In the severer cases this may be somewhat obscured by the presence of a certain amount of fluid in the cavity of the tunica vaginalis. Under ordinary circumstances, if untreated, this condition may remain stationary for several days; the pain then gradually subsides, and the redness and sensitiveness disappear. The induration is but slowly absorbed, from six to ten weeks often being required to effect its disappearance. Not infrequently a small nodule may remain at the head or tail of the epididymis for many years, which may cause a complete obstruction to the outward flow of semen. Instances have been known where the inflammation was so severe as to result in local necrosis, gangrene, and suppuration. In general, however, the prognosis regarding life and ultimate resolution is good.

Treatment.—The indications to be met in a case of acute epididymitis are, first, to relieve the hyperæmia and resulting pain; and, second, to

promote absorption of the inflammatory products. The former is best accomplished by absolute rest in bed, supporting the inflamed organ by some mechanical appliance, and the application of heat by means of fomentations and poultices. The flaxseed-meal poultice is the one generally employed, and when properly made, and applied with sufficient frequency, it affords prompt relief. The tobacco poultice has long enjoyed the reputation of being particularly serviceable in this condition, and is prepared by mixing a handful of fine-cut tobacco in half a pint of boiling water, and then adding a sufficient quantity of ground flaxseed to give it the required consistence. The advantage of this over the flaxseed poultice is due to the alleged narcotizing effect of the nicotine on the peripheral nerves. In a large number of cases, however, this method of treatment is, for obvious reasons, impracticable, and strenuous efforts have been put forth by surgeons for many years to discover, if possible, some means of relieving the pain and extreme tenderness without necessitating the patient's remaining in bed. The best method which has been suggested, up to the present time, is that by means of the actual cautery, first employed by Dr. W. S. Halsted. His method consists in lightly touching the surface of the skin overlying the affected organ with a white-hot cautery point. The operation requires only a few seconds, and, if skillfully performed, is but moderately painful. A dressing of iodoform-ointment is then applied, and held in place by means of a suspensory bandage. Instant relief from pain frequently follows the application of this treatment, and the patient is, as a rule, able to be up and walk about in comparative comfort. In a report entitled *Genito-Urinary Notes*, published by the writer in July, 1888, in the *Journal of Cutaneous and Genito-Urinary Diseases*, forty-six cases of acute epididymitis are reported which were treated by this method. In two instances only were the patients obliged to remain in bed after the first application, and in one of these the real cause of the enforced rest was a coexisting cystitis. Prompt relief from pain may also be had by removing the fluid collected in the sac of the tunica vaginalis by means of an aspirating needle. Other forms of counter-irritation, such as the application of a strong solution of nitrate of silver (forty to sixty grains to the ounce) and the ethereal tincture of iodine, have been employed, but these are inferior to the cautery, and often give rise to extensive sloughing of the epidermis. To promote absorption of the inflammatory induration, measures should be undertaken which insure the application of heat, moisture, mild counter-irritation, compression, and suspension. These indications are perhaps best fulfilled by the use of the *dry poultice*, first suggested by Langlebert, a report of which was furnished by the writer to the American Association of Genito-Urinary Surgeons in September, 1891, from which the following description is quoted: "The dressing consists in a moderately

thick layer of cotton-wool well applied over the inflamed testicle. This is covered by a layer of rubber protective tissue so fashioned that it completely incloses the diseased organ, with its edges extended on to the healthy skin of the scrotum in a manner to partly overlap but not entirely inclose the healthy side. This is secured by a snugly applied gauze bandage, and the whole held in place by a suspensory." This dressing, by retaining heat and preventing the evaporation of the moisture abundantly supplied by the sweat-glands, possesses all the advantages of an ordinary flaxseed poultice, and in addition exerts moderate compression, insures suspension, and allows the patient to be up and about.

This procedure has been extensively employed by the writer in hospital and private practice, and with the most gratifying results.

Strapping the testicle is a useful procedure, and, when properly applied, often promotes rapid absorption of the products of inflammation. To be of any value, it must exert compression and completely encircle the inflamed organ. To accomplish this the scrotum should be shaved, the healthy testicle pushed upward out of the way, and a circular band of pure rubber plaster placed above the organ in such a manner, and with sufficient tension, to prevent the testicle being drawn upward through the plaster ring. Alternate longitudinal and circular straps should then be applied until the whole is inclosed. This should be removed and reapplied as often as it becomes loosened.

Inunctions of mercurial ointment seem in some instances to hasten absorption. The advantages, however, are not sufficient to overcome the danger of constitutional disturbance which may follow its employment. For the pathological anatomy and further consideration of this subject the reader is referred to the chapter on the Diseases of the Testicle.

Peri-urethral Inflammation (*Folliculitis, Cowperitis, Prostatitis*).—An extension of the inflammation from the surface of the urethral mucous membrane to the glands and follicles emptying into the canal, and to the peri-urethral connective tissue, may constitute a complication of acute urethritis which is more or less serious, according to the location of the gland and the severity of the inflammation. This may take place anywhere along the course of the canal, but the usual sites of the inflammatory departure are at the fossa navicularis, at the bulb, or in the prostatic portion, for the reason that the glands are more abundantly located in these regions. If an inflammation, mild in character, extends along the membranous lining of a mucous follicle, or the duct of a racemose gland, the only result is often a localized point of induration and tenderness, and an exudation of pus from the gland into the urethra, which may continue long after the original urethritis has subsided. If the inflammation is more severe in character, the orifice of the duct or follicle may be occluded by swelling, and, as a result of the retention of the secretion, a

eyst may be formed which often attains the size many times that of the original gland, and which may finally rupture into the canal or externally, or gradually become absorbed and disappear. In more severe cases the inflammation may extend beyond the limits of the gland, and a peri-glandular cellulitis result, which in turn may extend rapidly along the tissues of the spongy or cavernous bodies of the penis, giving rise to extensive abscess, sloughing, and subsequent cicatricial contraction. An infiltration of urine not infrequently occurs when a peri-urethral abscess opens into the canal, especially when this opening exists behind a stricture. This may result in extensive destruction of tissue or a permanent urinary fistula.

Simple folliculitis frequently occurs in the minute glands situated in the neighborhood of the frænum. These are superficially located, and empty into the fossa navicularis. When inflamed, they appear as rounded, hard nodules on one or both sides of the frænum, corresponding in size to a small pea, tender to the touch, and covered by reddened mucous membrane. Softening takes place in three or four days usually, and a spontaneous external opening is established. Exceptionally, the opening may occur within the urethra.

Treatment.—The treatment of this condition consists in injecting the minute sac with a drop of pure carbolic acid or a concentrated solution of nitrate of silver. This is best accomplished by means of an ordinary hypodermic syringe and probe-pointed needle. One such application is usually sufficient to bring about a cure. If untreated, this small sac may continue to suppurate indefinitely, offering a constant source of urethral reinfection.

When the inflamed follicles are situated posteriorly to the fossa navicularis they develop somewhat more slowly, and more frequently undergo resolution. The patient complains of localized pain in the neighborhood of the urethral canal. The pain is of a dull, throbbing character at first, which becomes burning and often lancinating after the passage of urine or during an erection. Examination reveals the presence of a hard, rounded, tender nodule on the superior or inferior surface of the urethra. This increases in size, slowly at first, and may retain its rounded contour. In some instances it may attain the size of a large pea or cherry. Suppuration frequently occurs, and spontaneous rupture of the sac externally, no connection with the urethra, as a rule, existing. Occasionally the inflammatory process undergoes resolution, and the cyst remains for months and years as a rounded, elastic, painless nodule, which gradually disappears without symptoms. In the graver cases the inflammation extends rapidly beyond the limits of the gland or follicle, and results in a diffuse cellulitis, indicated by severe throbbing pain, and a tender, irregular induration, with œdema, chills, fever, and general *malaise*. In the milder cases, where the inflammation is confined to the gland, the treatment should consist in

rest, hot applications, and the inunction of an ointment of the oleate of mercury or white-precipitate. If suppuration occurs, the pus should be evacuated, as soon as detected, by a free incision. The cavity should be thoroughly cleansed with peroxide of hydrogen, and packed with aseptic gauze.

Cowperitis.—This is a name used to designate an infrequent complication of urethritis, namely, the involvement of one or both glands of Méry, located in the perineal region on either side of the *raphé* emptying into the bulbous urethra. The process of infection is exactly the same as in the folliculitis described above, the difference being only in the size of the gland. This complication occurs usually after the second week of the disease, and is characterized by pain in the perineal region, usually at first appreciated by the patient while sitting. Upon examination, a round, painful nodule about the size of a hazel-nut is felt midway between the scrotal junction and anal orifice on either side of the *raphé*. This rapidly increases in size, and may extend beyond the median line, and lose its rounded outline. In severe cases retention of urine may be occasioned by its pressure on the urethral canal. Suppuration is usually announced by the occurrence of chills, fever, and softening of the indurated mass. If untreated, rupture usually takes place externally, occasionally internally, very rarely in both directions, resulting in perineal fistula.

The treatment should consist in rest, hot applications, early incision, careful drainage, and thorough asepsis.

Prostatitis.—An inflammation of the prostate gland occurs in the same manner as the peri-urethral inflammations already described. It is, however, far more important than the others, for the reason that, on account of its intimate connection with that portion of the nervous and muscular system presiding over the sexual function, and the expulsion of the urine, its inflammatory involvement is accompanied by grave disturbances of these functions, and also for the reason that its location beyond the reach of direct remedial measures is such also as to render extensive suppuration and burrowing of pus most dangerous. Prostatitis rarely occurs before the end of the third week of the disease, unless the pus is carried directly to the gland by the passage of instruments or great carelessness in the use of injections. Two varieties of inflammation may occur in this gland as the result of gonorrhœal infection—the *follicular* and the *diffuse*. In the former, one or more follicles are involved; this gives rise to moderate pain and uneasiness in the perineal region, accompanied by frequent micturition, tenesmus, and sexual hyperæsthesia. These symptoms differ from those produced by a posterior urethritis only in the increased amount of pain in the perineal region, and the marked muscular spasm following urination. It is, however, impossible to arrive at a diagnosis of follicular prostatitis, except as a result of

rectal examination. This also may be negative; generally, however, some small points of induration may be detected in one or the other lobe of the gland. There is also well-marked tenderness on pressure.

In diffuse prostatitis the symptoms and physical signs are far more characteristic. In addition to the evidence of a posterior urethritis, perineal pain, frequent urination, and tenesmus, the patient experiences a sense of fullness and pressure in the rectum, with painful defecation, and, in severe cases, the passage of small, ribbon-shaped stools. Retention of urine may occur from pressure on the urethra. A rectal examination reveals the presence of an enlarged prostate, which may attain the size of a large orange and completely occlude the rectum. This is hard, hot, pulsating, and tender. Occasionally the prostate is found to be greatly enlarged, without subjective symptoms; generally, however, there are marked perineal weight and pain. The latter may become severe, and of a throbbing, boring character, extending along the urethra and into the thighs and testicles. Fever is usually present, and its degree furnishes a valuable criterion upon which to base an opinion regarding the prognosis. If the fever does not rise above 101° Fahr., and is unaccompanied by chills, sweating, and prostration, resolution without suppuration will probably occur. Indeed, resolution is the rule in diffuse prostatitis when the patient can have the advantages of skillful treatment. In these instances the symptoms disappear rapidly after the acme is reached, and the glandular enlargement progressively decreases until the examining finger fails to detect anything abnormal. When suppuration occurs, the fact is usually announced by a marked chill, high fever, and a considerable diminution in the perineal pain and tension. Fluctuation can occasionally be felt through the rectum. If untreated, rupture of the abscess takes place, most frequently into the urethra, occasionally into the rectum, very rarely through the tissues of the perinæum. In severer cases, where the inflammation extends beyond the capsule of the prostate and involves the periprostatic connective tissue, extensive suppuration and burrowing of pus may take place between the layers of the pelvic fascia within the pelvis, resulting in septic absorption and death. Not infrequently the abscess opens in two directions, as into the urethra and rectum, or urethra and perinæum, giving rise to fistulæ, which, if unrevealed, renders the life of the patient wretched beyond description.

Treatment.—When the diagnosis of acute prostatitis is made out, absolute rest in bed should be insisted upon. A calomel purge at the beginning often seems to exert a favorable influence over the course of the disease, although it may temporarily increase the rectal tenesmus. Leeches to the perinæum, followed by hot sitz-baths and hot rectal enemata, repeated three or four times a day, constitute the best treatment. Sufficient opium, in the form of suppositories, should be given to afford relief to the vesi-

cal irritation and tenesmus. The application of cold direct to the prostate through the rectum has found favor with some German surgeons. This is best accomplished by means of the cold rectal sound (Fig. 6), by which a stream of iced water is kept continually flowing through the hollow metal bulb introduced into the rectum.

If suppuration is inevitable, the pus is best evacuated by means of a perineal incision and subsequent drainage. In cases where spontaneous rupture occurs into the urethra the course is generally favorable, the abscess cavity rapidly filling with granulations. The healthy urine seems

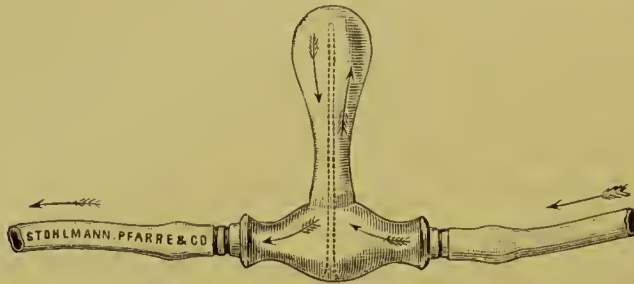


FIG. 6.

to exert in such cases no unfavorable influence. When the opening occurs into the rectum, however, the prognosis is not as favorable, as the introduction of intestinal gas and fecal matter into the cavity of the abscess tends to prevent healthy granulation, and may give rise to an indefinite continuation of the suppuration.

Impotence may result from acute prostatitis, from destruction of the seminal vesicles and their ducts by suppuration, or as a result of cicatricial contraction. Although chronic prostatitis frequently follows the acute follicular form of the disease, it can hardly be considered as a complication of acute urethritis. For its consideration, therefore, the reader is referred to the section on Diseases of the Prostate.

Vesiculitis.—An inflammation of the seminal vesicles and their excretory ducts. This occasionally occurs as a complication of acute urethritis. It is evidenced by a sense of weight, burning pain, and throbbing in the region of the vesical neck and rectum, extending to the scrotum, increased by defecation, and is accompanied by marked sexual hyperæsthesia, priapism, and frequent pollutions. The examining finger in the rectum detects one or both inflamed seminal vesicles as elongated, fusiform bodies on the posterior wall of the bladder just above the prostate. These are hot, and tender to the touch. This condition is usually accompanied by the symptoms of posterior urethritis. As a result of the heightened sexual appetite, frequent involuntary seminal emissions take place, accompanied by a throbbing, burning pain, and excessive voluptuous sensation. The fluid ejaculated is yellow or brownish in color, and upon

microscopic examination is found to be composed of pus, blood, and dead spermatozoa. Under favorable hygienic and therapeutic conditions the acute symptoms of this disease subside in from four to six days, and ultimate recovery may take place. Not infrequently, however, it becomes chronic, and may prove most rebellious to treatment. The symptoms of the chronic condition are milder in character, and are chiefly those of sexual neurasthenia, combined with those of a chronic posterior urethritis. It is to be differentiated from the latter, and from chronic prostatitis, by an examination of the fluid which may be pressed out by the finger in the rectum. This is best accomplished in the following manner: The patient is directed to pass a small amount of urine in a glass reservoir, after which the seminal vesicles are emptied by the method just described, and the remainder of the urine passed in two portions, and each preserved in a separate glass jar. The first specimen represents the washings from the urethra, the second the expressed contents of the seminal vesicles, and the third the urine as it is contained in the bladder. In chronic vesiculitis the second specimen should contain a larger amount of pus than the third, and, in addition, a number of dead spermatozoa. The proportionate amount of pus in the first specimen is determined by the amount of urethritis present, and is not of value in the diagnosis of vesiculitis. Temporary impotence as a result of vesiculitis is common, and due to the admixture of pus with the seminal fluid, which inhibits if not destroys the vitality of the spermatie elements.

Treatment.—In acute cases, rest in bed, opium suppositories, hot enemata, with sitz-baths, and saline laxatives. The psychrophore has been employed by Finger with success. Preparations of bromide of sodium with digitalis and camphor may often be found useful in subduing the sexual hyperæsthesia. To be of value, however, they must be given in large doses. The treatment of chronic vesiculitis is largely hygienic, combined with measures addressed to the usually present chronic urethritis. Cod-liver oil, iron, sea-bathing, and a change of climate will often be found more useful than local measures.

Cystitis.—The frequency of cystitis as a complication of acute urethritis has been greatly exaggerated. This is due to the fact that until quite recently the occurrence of frequent micturition, vesical tenesmus, and pus in the urine was thought to be pathognomonic of inflammation of the bladder, whereas we now know that these symptoms may indicate, and in fact generally do indicate, only an inflammation of the posterior urethra. It is a well-known fact that a very considerable amount of cystitis may exist without the occurrence of either frequent or painful micturition, provided the inflammation is limited to portions of the mucous membrane other than the immediate vicinity of the internal urethral orifice.

The subjective symptoms of this condition are somewhat misleading, often nothing more than a dull pain and sense of weight in the neighborhood of the symphysis pubis being present. There is tenderness in the hypogastric region, with moderate fever. Chills may occur in severe cases, with high fever and general *malaise*. In cystitis the urine soon becomes neutral or alkaline in reaction from the decomposition of urea. This, as Roosing has shown, is due to the presence of micro-organisms. The free alkali formed by this decomposition, by its action on the pus, forms a substance resembling mucin, which invariably collects at the bottom of the vesical reservoir, is expelled with the last portion of urine passed, and is pathognomonic of intravesical inflammation. In recent cases of cystitis, especially when the bladder is frequently emptied, this material may be absent.

Finger describes three conditions usually regarded as cystitis: First, *posterior urethritis*; second, *posterior urethritis with moderate cystitis in the immediate vicinity of the urethral orifice*; third, *cystitis without posterior urethritis*. These conditions can only be differentiated by a three-glass urine test. If the patient urinates in three glasses, the following facts will be observed regarding the gross appearance of the specimens:

Location.	First specimen.	Second specimen.	Third specimen.
Posterior urethritis.	Acid urine; <i>tripper faden</i> ; free pus.	Free pus.	Free pus.
Posterior urethritis with cystitis.	Urine acid or neutral; larger amount of free pus; <i>tripper faden</i> .	Free pus.	Free pus, with moderate amount of mucoid material.
Cystitis.	Urine neutral or alkaline; free pus.	Free pus.	Free pus, and large amount of mucoid material.

These tests are to a certain extent vitiated by the presence of hæmaturia or pus from the pelvis of the kidney. In the absence of these conditions, however, they may be relied upon as furnishing the most valuable data upon which to base a diagnosis.

For a review of the microscopic appearances of the urinary sediment, the reader is referred to the article on Urinary Analysis.

Pathology.—In cystitis due to gonorrhœal infection the inflammatory appearances are most marked in and about the urethral orifice. The appearance of the mucons membrane varies, from a slight thickening with moderate injection of the vessels to an intensely red, œdematous tissue covered with pus or fibrinous exudation. Hæmorrhages, erosions, and occasionally deep ulcerations, may be present in the severer forms of the disease. The prognosis in cases of acute cystitis is usually good, when the patient can enjoy the advantages of rational treatment. If the dis-

case is neglected, the condition soon becomes chronic and very rebellious to treatment. Occasionally the inflammatory process extends beneath the mucous membrane, and invades the connective tissue and muscular layer of the viscus (a condition described as chronic parenchymatous cystitis), with greatly thickened walls and marked diminution in capacity. This is practically incurable, and will be described further in the article on Cystitis.

Treatment.—As in other inflammatory conditions of the genito-urinary tract, rest occupies the first position in the successful treatment of cystitis. Diuretics are of decided value in increasing the secretion of urine and preventing decomposition by frequent emptying of the bladder. The oil of sandal-wood in full doses seems often to exert a happy influence upon the severity of the symptoms, and in connection with other local measures may be of positive value. Sufficient opium, in the form of suppositories, should be given to relieve the pain and bladder tenesmus, if present. After the acuteness of the attack has subsided, the gentle washing out of the bladder by means of a fountain syringe and soft-rubber catheter with a dilute solution of salt in sterilized water, or, better, a two-per-cent solution of salicylic acid, serves to remove the pus and mucoid material. This should be followed by a mild solution of nitrate of silver from 1 to 5,000 to 1 to 1,000. The internal use of boric acid, in doses of five to ten grains three or four times a day, with the view of sterilizing the urine and preventing the development of bacteria, has been extensively used of late, especially in France, and often with gratifying results.

Pyelitis.—Inflammation of the mucous membrane lining the pelvis and calices of the kidney. This occasionally occurs as a complication of gonorrhœal inflammation when the latter has infected the bladder. The occurrence of this complication is favored by conditions which impede the outward flow of urine, as urethral stricture, prostatic enlargement, and pressure upon the ureters, by unfavorable hygienic surroundings, a vitiated constitution, and the abuse of alcohol.

Pathology.—In the acute form of the disease the mucous membrane appears deeply injected and thickened, and the cavity of the renal pelvis contains a mixture of urine, blood, and pus. In the severer forms minute hæmorrhages may be present, and occasionally a fibrinous pseudo-membrane. The redness extends often into the ureter.

Symptoms.—The symptoms of this disease are pain in the lumbar region, extending downward to the bladder, scrotum, and thighs, increased by exercise; frequent micturition, reflex in character, simulating posterior urethritis; and a moderate amount of fever with chills and profuse perspiration, when the secretions are for any reason retained. In mild cases any or all of these symptoms may be wanting. The physical examination is usually negative, or shows at most only slight tenderness over the kidney

region. The examination of the urine furnishes the only reliable evidence of the disease. The usual characteristics of a pyelitic urine are the increased amount, pale color, cloudy appearance, acid reaction; when allowed to settle, the pus forms a thick, compact, creamy mass at the bottom of the glass. Albumen is present in a greater amount than is sufficient to account for the pus. The microscope reveals, in addition to an abundance of pus, an occasional hyaline or granular cast; in severe cases, blood may also be present in the sediment. The question as to whether the presence of any characteristic epithelial cell may be said to indicate positively the renal origin of the pyuria in a given case, is far from being definitely settled.

Prognosis.—In uncomplicated cases of acute pyelitis of gonorrhœal origin recovery may be expected, although the presence of pus in the urine may continue for months or years. When marked obstruction to the outflow of urine exists, or a chronic inflammation of the lower urinary passages, the outlook is more grave, as the long continuance of pyelitis invariably leads to pathological changes in the parenchyma of the kidney and resulting nutritive disturbances.

Treatment.—This is mainly hygienic, and consists in removing as far as possible the cause which led to its occurrence, providing absolute rest in bed and the strict avoidance of stimulating food and drink. If the pain be severe, marked relief can often be afforded by the external application of heat in the form of fomentations and poultices, or by the employment of dry cups over the lumbar region. Diuretics are of positive value, and should be used freely. The best agent to be employed is pure water taken in large amounts. Salol, boric acid, and the balsams have been used by many, and may exert at times a happy influence over the course of the inflammation. Beyond this little can be done.

Balanitis.—An inflammation of the mucous membrane covering the glans penis. This occurs frequently during the course of an acute urethritis. As it is a generally recognized fact that the gonococcus develops only under exceptional circumstances upon pavement epithelium, the balanitis is probably the result of a primary irritation and erosion from the caustic action of the gonorrhœal pus, and later an infection by means of some other pathogenic organism. The conditions which favor the occurrence of this complication are uncleanness and the presence of a long, tight prepuce.

The mucous covering of the glans will be found to be intensely red, and covered with an abundant secretion of foul-smelling pus. Superficial erosions may be seen, especially over the corona and in the sulcus immediately behind. The subjective symptoms are a sense of heat, soreness, and occasionally throbbing pain. With this is usually associated a certain amount of sexual hyperæsthesia.

Treatment.—Prophylactic; circumcision and cleanliness. During an attack; frequent bathing, constant exposure of the glans, applications of hot water, and lead and opium wash; later, iodol or some other unirritating dusting-powder.

Phimosis.—By this is understood an abnormal narrowing of the preputial orifice, preventing complete retraction of the foreskin. This condition may be congenital or acquired. As a complication of acute urethritis, we have to do only with the acquired variety, which is occasioned by an inflammatory œdema of the skin and connective tissue.

As a result of this inability to retract the prepuce, the secretions from the urethra collect between the glans and inner layer of the foreskin, and give rise to balanitis, with erosions and often ulcerations of the mucous membrane, adding greatly to the discomfort of the patient.

Treatment.—This consists in cleanliness, and the application of heat to reduce the œdema. The former is best accomplished by the injection into the preputial sac of a saturated solution of boric acid, or some other unirritating antiseptic fluid, by means of a long, pointed glass syringe; the latter, by soaking the penis in hot water five or six times during the day. After the preputial sac has been thoroughly cleansed of pus, an injection of black-wash should be made and allowed to remain.

Paraphimosis is the name applied to that condition produced by the forcible retraction of a phimotic or infiltrated prepuce. The constricting ring which forms the narrow orifice of the prepuce compresses the superficial veins which should convey the blood from the glans penis. As a result of this pressure, the glans rapidly swells and becomes œdematous and livid. In rare instances, where the swelling is extensive and the constriction unrelieved, gangrene may result. Generally, however, the constricting band sloughs, relieving in a measure the strangulation of the parts, and the swelling gradually subsides.

Treatment.—This should consist in hot applications, gentle compression to reduce the size of the glans, and final reduction after the manner described under Diseases of the Penis.

Lymphangitis and Adenitis.—In severe cases of urethritis the lymphatics and neighboring glands may become involved. The former are more frequently affected than the latter. In simple lymphangitis the swollen vessels can usually be felt as hard cords generally on the dorsum of the penis. In rare instances the lymphatic cord can be traced direct to the inguinal glands. If the inflammation is severe, the integument overlying the inflamed lymphatic canal is reddened, hot, and tender, and may be accompanied by œdema of the skin and connective tissue. One or more inguinal glands may become enlarged and tender. There is, however, but slight tendency to suppuration, and when this does occur it is in all probability due to a mixed infection.

Treatment.—The only measures required for this condition are rest in bed, hot fomentations, and measures directed against the original urethritis.

Various skin eruptions, such as purpura hæmorrhagica, erythema multiforme, and urticaria, have been observed during the course of an acute urethral inflammation; also endocarditis, iritis, and other diseases: but as there is no reason to suppose that the association is other than accidental, they will not be included among the true complications of this disease.

Gonorrhœal rheumatism and gonorrhœal ophthalmia will be considered in separate sections.

CHRONIC GONORRHŒA OR GLEET.

By WILLIAM K. OTIS, M. D.

Etiology.—The continuance of a urethral discharge for a period longer than two months from the inception of the disease is inevitably due to the presence of some pathological condition in addition to the original cause of the inflammation, thus preventing the natural tendency to spontaneous cure. These pathological changes consist in isolated granular patches on the urethral mucous membrane, which may occur at any point in the urethral tract, and which fail to heal because of plastic infiltration of the submucous tissue, causing more or less coarctation of the canal at these points. These infiltrations, according to Mr. Reginald Harrison and others, are the result of an attempt on the part of Nature to prevent the leakage of urine through mucous membrane which has been denuded of its protecting epithelium by a superficial inflammation; but the more probable view, and the one most generally held, is that the inflammatory action extends deeply into the urethral and even the peri-urethral tissues, causing the deposit of plastic material. This finally results in a true cicatrix, similar in all respects to that following a burn of the skin or of other tracts lined with mucous membrane, not subject to contact with irritating fluids.

The *rôle* which the gonococcus plays in the production of these infiltrations is not well understood, but in all probability it penetrates the deeper tissues and is the direct cause of the inflammatory deposit which subsequently becomes organized cicatricial tissue. Coarctations may have existed in many cases long before the discharge which they prolong, and were originally due to morbid conditions of the urine in early childhood—e. g., an excess of uric acid, which at the time may have passed unnoticed.

In a small minority of cases of chronic gonorrhœa no stricture will be found to be present, the discharge being prolonged by either the involvement of the sinuses and glands of the urethra (which are much more numerous and of greater depth than is generally supposed), by the presence of neoplasms, or by the general condition of the patient; but, as a rule, these cases yield readily to treatment, which, at all events, is identical with that pursued in other cases after all stricture has been removed.

Diagnosis.—In the diagnosis of chronic urethritis it is exceedingly important that the location of the diseased areas should be carefully determined. It is well to follow the classification of Ultzmann, who divides the urethra into two portions, the anterior and the posterior. The anterior urethra is that portion situated in front of the compressor urethræ muscle; the posterior, including the prostatic and membranous, is the portion situated between the compressor urethræ muscle and the internal sphincter of the bladder.

If the anterior urethra alone is invaded, and the patient be required to urinate half the urine into one glass and the remainder in a second glass, only the first half will appear cloudy, while the second half will be perfectly clear. If, on the contrary, the posterior urethra is the seat of the disease, the discharge, unable to overcome the pressure of the strong compressor urethræ muscle in front, flows backward into the bladder, and its entire contents will be clouded. In cases where the secretion is scanty, the anterior urethra may be washed out with a solution of salicylic acid, one sixteenth of one per cent, through a soft-rubber catheter passed down to the bulbo-membranous junction. Several ounces of the fluid should be injected by means of a hand syringe, allowing the solution to escape alongside of the catheter, thus completely cleansing the entire anterior urethra.

If now the patient urinates in two portions, and the first portion is cloudy, while the second is clear, the inflammation is situated in the posterior urethra. Should the seminal vesicles be suspected, the urine should be passed into three separate glasses; the first will contain the washings of the urethra, including the neck of the bladder; the finger should then be passed into the rectum and pressure brought upon the seminal vesicles on both sides; the second third of the urine being now passed into a clean glass, immediately followed by the passage of the remaining urine into a third glass. If the intermediate portion is more opaque than the other two, the seminal vesicles are undoubtedly affected.

The discharge itself may be exceedingly profuse, or it may be so scanty as to remain unnoticed by the patient, appearing only as discharge in the form of a single drop in the morning (*goutte militaire*), or it may only appear in the form of threads in the urine. These threads (*Tripperfäden*) consist of an amount of purulent secretion exuding from the granular patches, too small to appear as discharge, which, being washed out by the stream of urine, are rolled up in the form of threads and appear as such floating in the urine. They consist of transparent, cylindrical masses, in which numerous pus-corpuscles and a few urethral epithelial cells are imbedded. The more compact such fiber seems, the more pus-cells it contains. If, on the other hand, it is transparent, it consists for the most part of urethral epithelium, with but little pus.

The more the epithelium predominates in such a thread the nearer the process is to a cure. Those threads which are principally composed of epithelium have a tendency to float, while those composed chiefly of pus sink rapidly to the bottom.

The attempt has been made to localize the seat of the inflammation by the gross appearance of these threads, the thick, short threads and those which frequently assume the form of a polliwog being supposed to come from the deep urethra, the thinner and longer threads from the anterior to the triangular ligament. This method is so misleading, however, as to be practically without value, and it is only when we discover spermatozoa entangled in the thread that we can definitely conclude that it is formed in the prostatic urethra.

Treatment.—It may be said that the sooner treatment is begun after the disease has arrived at the subacute stage the better. At this time the infiltrations, not having had time to become organized into cicatricial tissue, consist of plastic material alone, and frequently yield to simple dilatation without the necessity of resorting to a cutting operation.

Local Treatment.—The first step in the treatment of a plastic deposit in the subepithelial tissues is to prevent the abnormal development of epithelial structures. The superficial erosions and granulations of the urethral mucous membrane in chronic gonorrhœa are due, as has been already shown, to the implication of the deeper layers, and therefore it is certainly not logical to attempt a cure without directing the treatment to this, the underlying cause of the continuance of the discharge. Pressure is a most serviceable agent in these cases, and is best exerted by the passage of full-sized sounds, which should be allowed to remain in the urethra for three or four minutes each day. As it is manifestly impossible for a solid sound to exert pressure on a urethra in which, as is so frequently the case, the meatus is the smallest portion, it will often be necessary to divide this up to the normal caliber of the canal behind it, cutting on the *inferior* surface with a blunt-pointed, straight bistoury—this for the reason, chiefly, that incisions *superiorly* in the glans retract quickly, or, if they do not, absorption of the tissue of the glans may occur in the line of the incision, if at all extensive, which may result possibly in a distinct cleft. The enlargement of the orifice should never be made by a sudden, quick stroke of the knife, as it is sometimes the custom of surgeons, but under cocaine or ether, very deliberately, and by repeated careful incisions, always downward, and exactly in the median line, until by repeated trials with the bulbous sound the precise size required is attained. Should the frænum be in the way, if broad and flat, the incision may be carried through its center as far as its base; if narrow, it should be first snipped away to the same extent. When the meatus is situated too low to allow sufficient room, the surgeon must content him-

self with an inferior incision that shall not encroach upon the true floor of the canal, and will have to use the urethrometer or its equivalent, instead of the sound, for keeping the sundered ends of the strictures from uniting until healing of the incision is complete. The importance of this operation where the meatus is small can not be overestimated, discharges which have resisted treatment for many years frequently recovering spontaneously after its performance.

No matter in what portion of the canal the disease may be located, the first indication for successful treatment is the removal of all mechanical obstacles to a cure. The urethra should be carefully examined by means of the urethrometer and bulbous bougies, and all coarctations, no matter how slight, carefully noted. As a thorough examination of this kind is somewhat painful, it is well to inject half a drachm of a four-per-cent solution of cocaine by means of an Ultzmann or other syringe, lubricated with glycerin; then, after a few moments, the urethrometer is introduced, closed to the bulbo-membranous junction, and slowly dilated to the size previously estimated, after the rule of Otis * (Figs. 1, 2, 3), and drawn gently forward until it is stopped by the presence of some contraction. The size and extent of this having been noted, it is again dilated and drawn forward until it is again stopped. In this way a perfect map of the urethra is obtained. The bulbous bougies are exceedingly useful in cases in which the lower strictures are smaller than the meatus, or where the meatus has been divided, giving a somewhat more clean-cut impression than does the urethrometer.

All pathological narrowings should now be removed, preferably by dilating urethrotomy, although in recent cases simple dilatation will often prove sufficient.

Injection.—The mechanical obstacle having been removed, we may proceed to the treatment of the diseased mucous membrane with some chance of success. If the disease exists in the pendulous urethra alone, it may occasionally be cured by means of injections with the ordinary pointed urethral syringe (Fig. 4), together with the passage of a full-size straight sound on alternate days. The syringe should have a capacity of not more than two drachms, and the injection should never be sufficiently

* Otis, Stricture of the Male Urethra, p. 89.

CIRCUMFERENCE MIDWAY OF THE FLACCID PENIS.

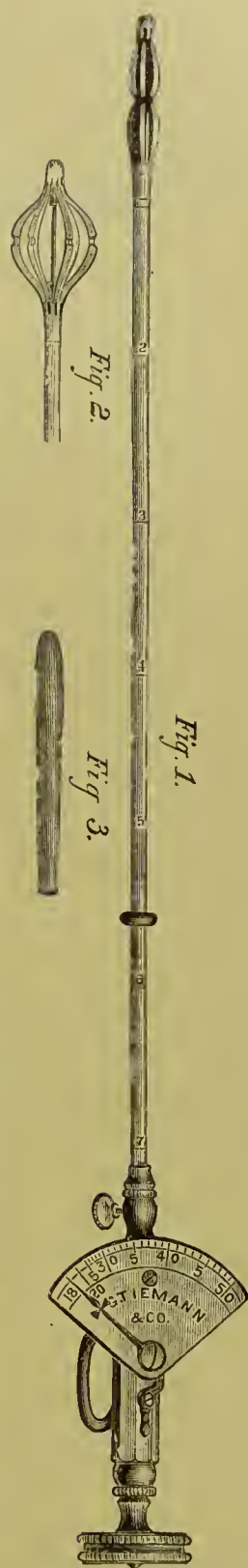
<i>Of Penis.</i>		<i>Of Urethra.</i>
3 inches,	or 75 millimetres.	30 millimetres, or more.
3½ inches,	or 81 millimetres.	32 millimetres, or more.
3¾ inches,	or 87 millimetres.	34 millimetres, or more.
3⅞ inches,	or 93 millimetres.	36 millimetres, or more.
4 inches,	or 100 millimetres.	38 millimetres, or more.
4½ to 4¾ inches,	or 105 to 112 millimetres.	40 millimetres, or more.

strong to cause more than passing irritation. These injections may consist of any astringent, vegetable or mineral, but should always contain an antiseptic element.

When, however, the disease has extended into the bulbous portion of the urethra, it will be necessary to use some other means of medication. A soft-rubber catheter (14 French) with two lateral openings may be passed in as far as the bulbous portion of the urethra, allowing the medicated solution from an irrigator to flow slowly along the sides of the catheter, thus washing out the entire anterior urethra from the compressor urethræ muscle.

The involvement of the posterior urethra can not be regarded as a complication, but rather as a phase of the disease, which is occasionally, though rarely, absent. According to Letzel and Trzeinski, 92.5 of all cases became posterior and chronic. In fifty cases observed by Heisler, twenty per cent became posterior in the first week, seventeen at the end of the second week, seven at the end of the third week, and ten at the end of the fourth week.

It is desirable in the treatment of chronic gonorrhœa, where, as is usually the case, the entire urethra is more or less involved, that a definite system of treatment should be decided upon, varying somewhat in each case according to the tolerance of the patient. The system devised by Ultzmann is convenient, and is usually effective. It consists in the application of various solutions to the membranous and prostatic urethra, and to the mucous membrane of the bladder. For this purpose he uses either his own silver catheter with slit openings, or an ordinary stiff catheter (Coudé, 15 French) having two lateral openings. This is anointed with glycerin and introduced just beyond the compressor urethræ muscle. A hard-rubber syringe of three or four ounces capacity, filled with a medicated solution, is then attached by means of a short piece of soft-rubber tubing to the end of the catheter, and the fluid gently injected into the membranous urethra, whence, easily overcoming the resistance of the weak internal sphincter vesicæ, it flows into the bladder. This is repeated until the bladder



FIGS. 1, 2, and 3.—Otis's urethrometer.

is completely full, when the patient immediately empties it through the urethra. The end of the catheter is known to be in the neck of the bladder by the fluid not flowing out alongside of it through the urethra, or, when the syringe is removed, through the catheter itself. It is well to begin with a mild solution, gradually increasing the strength each day, and combining this treatment with the use of the solid sound.



FIG. 4.—Conical-pointed syringe.

A favorite method of Dr. Ultzmann was to begin with a solution consisting of zinc sulphate, alum. crud., acetic acid, 1 part; water, 500 parts; on the first day diluting this with water three times; on the second, twice; and on the third, once; then using it full strength. If this is well borne, it is changed for a solution of permanganate of potash, 1 to 2,000, increasing to 1 to 1,000, when a 1-to-2,000 solution of argentic nitrate is substituted and gradually carried up to 1 to 1,000. The solution should be warm. At about the end of the second week, in place of the irrigation on every third day, an instillation or "etching" of a few drops of a five-per-cent solution of argentic nitrate is made into the neck of the bladder by means of the drop catheter or syringe. This consists of a capillary-tubed catheter with a straight shaft of rather abrupt curve, to which is attached an ordinary hypodermic syringe. The desired amount is drawn into the syringe, and the catheter introduced until the end has passed the membranous portion, which is indicated when the long axis of the catheter is 45° from the vertical, showing that the triangular ligament has been passed. If the application has been properly made, none of the injected fluid will return, and a desire to urinate will be felt soon after the application. This treatment is especially effective in cases of irritability of the vesical neck. Applications should be repeated only after a period of two or three days, or until after the effects of previous applications have passed entirely away. The strength of the solution may be increased up to as high, in some cases, as sixty grains to the ounce, though in others it will be found necessary to begin with a mild solution, even as low as one or two per cent.

Guyon, who formerly used a method very similar to that of Ultzmann, has recently introduced a plan of treatment consisting in the use of solutions of the bichloride of mercury, beginning with a mild solution—1 to 30,000, or even 40,000, and gradually carrying it up to 1 to 20,000. He fills the bladder in the same way, allowing the patient to empty it through the natural route, thus washing out the entire urethra.

After a time it will be noticed that this treatment causes so much irritation that little benefit results, when the irrigations are immediately stopped, and instillations, by means of the drop catheter, of a solution of

the bichloride of 1 to 3,000, gradually increasing up to as high as 1 to 1,000, are used. Usually these "etchings" are somewhat painful, the pain not coming on as rapidly as when the nitrate of silver is used, but lasting somewhat longer, and being much more severe. This treatment will often be found exceedingly serviceable in those cases which have resisted attempts at a cure by means of the nitrate of silver, but in other cases it has proved to be much less efficient than the silver solutions.

The method introduced by Neisser consists in the injection into the bladder of a 1-to-8,000 solution of the nitrate of silver. The catheter is passed into the bladder and slowly withdrawn, the fluid being injected until the catheter has passed the compressor urethræ muscle. The solution first flows back into the bladder, and then forward, alongside the catheter. The first day a solution of the nitrate of silver, 1 to 8,000, may be used, the patient retaining for two hours the portion injected into the bladder. This is repeated daily, and in a few days the discharge usually ceases, leaving only the threads, which as a rule disappear in a few weeks. Toward the end of the treatment it is only necessary to make the injection every two or three days. Some patients are unable to bear even so weak a solution as 1 to 8,000, or the irritation caused by the injection and the passage of the catheter is so great that the daily injection is not advisable. In these cases it will be necessary for the surgeon to use considerable judgment, neither pushing the injection to such a strength as to cause the patient an inordinate amount of pain, nor so much irritation of the urethral mucous membrane as to produce itself the very condition which he is endeavoring to cure.

Suppositories.—When the posterior urethra alone is involved, a favorite method of treatment by many surgeons is the introduction of suppositories by means of the *porte-remède* of Dittel. This consists of an ordinary silver catheter, nine and a half inches in length, open at the distal end, but with a well-fitting obturator with a flexible stem. The obturator in place, the instrument is introduced until the end lies in the posterior urethra, when the obturator is withdrawn and a medicated pencil of cocoa-butter inserted into the proximal end of the instrument and pushed down into the prostatic urethra by reinserting the obturator. These suppositories may be simply astringent, or they may be made to act even as a caustic.

Another method of treating the urethra in these cases is by the introduction of a sound smeared with some form of medicated ointment, either the ordinary smooth sound or one in which depressions have been made in order better to carry the medicament.

Endoscopic Treatment.—Owing largely to the efforts of Grünfeld and Oberländer, and to the introduction of new instruments, one of the most satisfactory methods at our disposal for treating the conditions met with

in chronic urethritis is by the use of the endoscope. By this means the mucous membrane can be carefully examined, and isolated spots touched with very much stronger solutions than could be used by any other method. The advantages of this are manifest. The most advantageous form of urethroscope is that which will admit of ready access of instruments through the tube, and in which the illumination is sufficient to detect the smallest lesions of the urethral mucous membrane.

In most forms of endoscopy in which reflected light is used, either there is no room for the introduction of instruments, or there is so much extraneous light that after a little time the eye becomes dazzled and tired, very much as one feels after looking at snow. In order to overcome these difficulties, I have constructed a urethroscope, consisting of a small metal cylinder one and a half inch long by one inch in diameter,

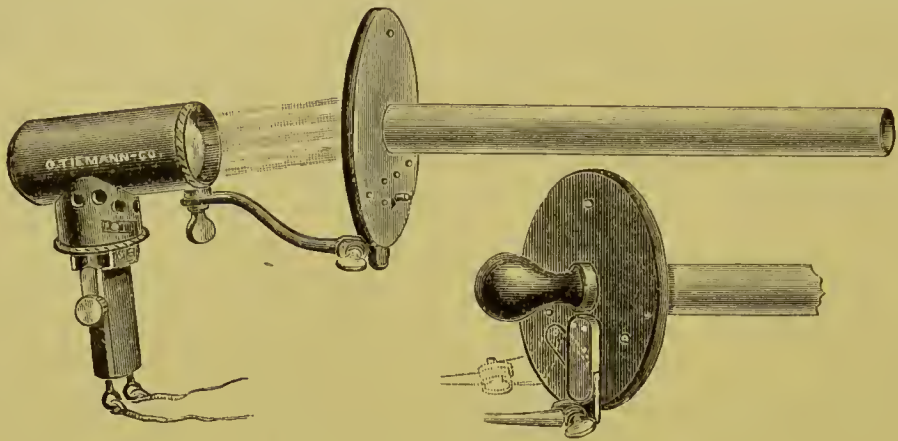


FIG. 5.—Otis's electro-urethroscope.

one end of which is open. Within this cylinder, one quarter of an inch distant from the open end, is a miniature incandescent electric lamp, placed directly behind a convex lens. The electric connections with the lamp are placed in a piece of hard rubber one inch long, which serves as a handle to the instrument, a cut-off being so arranged that the lamp is under control and can be turned on or off, or renewed at pleasure. A stout wire one and a quarter inch in length connects the instrument with the top of the plate of the Klotz's urethroscopic tube by means of a small, flat foot at its distal end, at the outer extremity of which is a smooth pin. This pin fits in a hole in the top plate, and on revolving the instrument a quarter circle the foot swings under a shoulder attached to the plate and is securely fastened. This joint is firm and easy of manipulation, readily allowing the illuminator to be attached or removed at any time during the examination. Hinged joints, swinging in opposite directions at each end of the wire, allow the instrument to be turned in any direction. The rays of light passing through the lens are thrown down the tube, and the illuminated field is easily observed by an eye

looking over the top of the cylinder. The advantages of the instrument are the exclusion of all extraneous light, a very much more ready access to the urethral field both to the eye and for instrumental applications, and greatly increased illumination.

The instrument is also very light and compact, being much smaller and only one seventh the weight of the Leiter instrument. The eye may be placed much nearer the mucous membrane to be examined. Its great simplicity of construction should insure a moderate cost.

The tube being passed down to the bulbo-membranous junction, the obturator is withdrawn and the instrument applied. Granular spots are easily detected under the strong illumination, and with a little practice the openings of the glands can also be seen.

In making applications, the strong solutions only are of value. Sixty grains of the nitrate of silver on a cotton swab, pure iodine, or even lunar caustic, or the electric actual cautery, may be used. As it is rather difficult to remove the cotton from the end of the applicator after it has been used, the little sticks employed by florists to attach flowers are very serviceable as applicators, and may be thrown away after using once.

Drainage.—In certain cases the invasion of the posterior urethra is attended with chronic tenesmus and frequency of urination, the patient rarely being able to retain more than an ounce or two of urine at a time, and is obliged to micturate every hour, or even more often. He has to wear a urinal, or to constantly remain near some place where he can relieve himself, and, from pain and attendant want of sleep, loses flesh and strength, and becomes so nervous and irritable that life is scarcely bearable either for himself or his friends.

In these cases, which are often mistaken for tuberculosis, local treatment seems to aggravate rather than alleviate the condition, the irritation caused by the introduction of instruments being greater than any benefit derived from the medicated solution. The bladder requires a complete rest, and that for a considerable period, at least several weeks. To establish this the most efficient means is by drainage through the perinæum. The patient having been etherized and placed in the lithotomy position, the perinæum shaved and rendered thoroughly aseptic, a grooved staff is passed into the bladder and firmly held in the median line by an assistant, the bow of the staff being pressed outward toward the operator, who sits in front, and with the left forefinger in the rectum feels for the apex of the prostate. An incision is now made through the skin and superficial structures, about one inch in length, its lower end being about an inch above the margin of the anus. A long, straight bistoury is then passed along the finger into the groove of the staff and the urethra divided for a little over a quarter of an inch. A director is then passed through the incision along the groove in the staff into the bladder and

the staff removed. The right forefinger may now be inserted and the interior of the bladder thoroughly explored, which is greatly aided by pressure with the other hand above the symphysis. The attendant overstretching of the vesical neck is in all probability exceedingly beneficial, acting by temporarily paralyzing the sphincter, as is done in the case of the sphincter ani in the operation for fissure. A large rubber catheter is now passed through the wound, extending into the bladder cavity only just so far as to drain it, and is held in place by a silk stitch passing through the edges of the wound and the catheter. The patient being put to bed, the end of the tube is placed in a bottle and the bladder allowed to drain freely. At the end of two or three days the stitch is removed and the tube thoroughly cleansed. The bladder should be washed daily through the tube, such solutions being used as cause no undue amount of pain. The tube should be frequently cleansed from any deposit of calcareous material. The relief from this operation is usually instantaneous, and the bladder should be allowed to drain as long as possible, at least for a period of several weeks.

The duration of the contagious period of the discharge is a question of great importance, and one which is not at all easy to decide. It has been made doubly important of late by gynæcologists, who have pointed out that many uterine, tubal, and ovarian diseases are due to contagion from this source. Though we are unable always to detect the gonococci in the discharge or in the *Tripperfäden*, it is quite evident that they lie hidden in the crypts and intercellular spaces of the urethral mucous membrane, ready to bloom forth upon any exciting cause, such as overindulgence in stimulants or sexual intercourse. Thus we often find patients who have once contracted gonorrhœa continually complaining of their misfortune in the frequency with which they contract new attacks from sources which they considered unimpeachable, whereas in reality it is simply a rekindling of the old malady. While it is probable that the contagious element is not present when *Tripperfäden* alone exist, yet at any time these cases may present a discharge which is contagious. No patient should be allowed to marry within a year after the total disappearance of all discharge, until all stricture has been removed from his urethra, and until the *Tripperfäden* consist of epithelium alone. In regard to this last, however, even normal urethræ which have never been subjected to the invasion of the gonococcus occasionally throw off *Tripperfäden* containing white cells, so that it will be necessary for the practitioner to use judgment as to the nature of the *Tripperfäden* in each case.

The great majority of men having gonorrhœa recover entirely, at least so far as any infectious element is concerned. They marry, and their wives remain perfectly healthy, even though the husbands continue

to pass urine containing threads composed largely of white cells, and while uncured gonorrhœa is undoubtedly responsible for a certain amount of ovarian and tubal disease, the probabilities are that this factor has been overestimated.

General Treatment.—In regard to the general treatment of cases of chronic gonorrhœa, it is not necessary to restrict the patient nearly as closely as when the disease is acute. Avoidance of excessive indulgence in alcoholics, particularly champagne and beer, care of the general health, moderate exercise, avoiding horseback and bicycle riding, or too violent exercise, and avoidance of sexual intercourse, are advantageous in these cases, but, after all, it is through local treatment that we must expect to effect a cure.

Finally, in those unfortunate cases which are also the subjects of tubercular infection, the tubercle bacillus and the gonococcus appearing side by side in the discharge, the prognosis is exceedingly grave. In these cases local treatment, as a rule, is worse than useless—in fact, is often harmful, although in some cases emulsions of iodoform may prove of service. It has been suggested by Belfield that the trichloride of iodine, beginning with a solution of one quarter of one per cent, and increasing to one per cent, might be of service; but should these remedies fail, a sea-voyage, or life in some salubrious climate, is all that can be suggested to aid these unfortunate sufferers.

EXPLANATION OF FIGURES ON PLATE II.

1, Normal urethra, near fossa navicularis; 2, normal urethra, anterior portion of pendulous part; 3, normal urethra, posterior portion of pendulous part; 4, normal urethra, central portion, parietal position of tube; 5, normal urethra, lacunæ Morgagni, one enlarged, parietal position; 6, normal urethra, bulging in of mucous membrane (caliber of tube smaller than that of urethra); 7, normal urethra, membranous portion; 8, normal urethra, anterior portion of colliculus seminalis protruding between lateral folds; 9, normal urethra, colliculus seminalis, with aperture of uterus masculinus; 10, colliculus seminalis enlarged and hyperæmic; 11, membranous portion (new formation of blood-vessels), hyperæmic condition in shape of stripes; 12, diffuse hyperæmia and œdema of mucous membrane (pendulous portion); 13, patch of granular condition; 14, 15, later stages of granular condition, with infiltration of subepithelial tissue; 16, epithelaufagerungen (new formation of epithelial layers); 17, 18, patch of granular condition with lacunæ Morgagni, before and after local treatment; 19, polyp of membranous portion; 20, papillary excrescences (vegetations) of pendulous portion; 21, 22, large polypus (central position) (Grünfeld); 23, cicatricial stricture (Grünfeld); 24, old cicatricial stricture after dilatation (Grünfeld).



ENDOSCOPY.

By HERMANN G. KLOTZ, M. D.

THE urethra is not directly accessible to examination by the human eye. It is true, by pressing the orifice between two fingers in a perpendicular direction the lips of the meatus will separate sufficiently to allow the inspection of a portion of the fossa navicularis, or, by extending the meatus by means of the blades of a forceps, the mucous membrane may be seen to the depth of nearly one inch. But to look beyond that distance some contrivance is needed; first, to hold asunder the walls of the urethra, which naturally are in close contact; and, second, to illuminate the cavity thus formed sufficiently to render it distinctly visible at a certain distance. The instruments which have been constructed for this purpose are called *endoscopes*, and the art and practice of examining the inside of the urethra by means of such instruments, *endoscopy*. These words are derived from the Greek *ἐνδον*, *within, inside of*, and *σκοπεῖν*, *to view*, and simply mean inspecting the interior. By analogy with the terms used for the visual examination of other interior organs of the human body, as the eye, the larynx, the urinary bladder, viz., ophthalmoscopy, laryngoscopy, cystoscopy, etc., it would be more correct—as, in fact, is frequently done—to use the terms “urethroscopy” and “urethroscope.” But since Désormeaux made known his instrument under the name of the endoscope, the general term has almost universally been applied to the examination of the urethra alone, and by an endoscope we understand, as a rule, an instrument for the examination of the urethra. The conditions for the examination of the urethra being somewhat similar to those of the vagina, only much less favorable for illumination on account of the narrowness and length of the urethra, most of the apparatus intended for the purpose of distending its walls follow the shape of vaginal specula, the simple cylindrical speculum being the prototype for most of the tubes introduced into the urethra, while a number of bivalve specula have been devised at different times. But the problem of lighting the cavity of the urethra presented much greater difficulties, and led to the construction of a number of complicated and impractical apparatus, their authors endeavoring to unite in one the different parts necessary for the purpose.

Development of the Endoscope.—The first instrument which actually stood the test of practice was that of A. J. Désormeaux, of Paris, presented in 1853 to the Academy of Medicine. In 1865 he published the practical results obtained with it in his book on The Endoscope and its Applications to the Diagnosis and Treatment of the Affections of the Urethra and of the Bladder. Désormeaux's instrument was still far from perfect, and the numerous surgeons all over the civilized world who took interest in the subject at once set to work to improve upon it by applying better sources of light, gradually separating the light itself from the instrument proper, and reducing the latter to more simple forms. The decided innovation, to use for illumination the common laryngeal mirror fixed to a head-band or handle as a reflector, without any connection with the tube proper, was made in 1862 by August Haken, a practitioner of Riga. This method was soon adopted by other surgeons, particularly by Joseph Gruenfeld, of Vienna, who, by a number of publications beginning in 1874, has probably done more than any one else to demonstrate to the profession in general the comparative simplicity and the practical value of endoscopy. Gruenfeld has given an almost complete history of the development of the endoscope, with a description of the older instruments, in a paper published in the *Wicner med. Jahrbuch*, 1879. The literature of endoscopy has already assumed considerable proportions. An almost complete list up to 1880 is found in Gruenfeld's book, *Die Endoscopie der Harnröhre und Blase*, which appeared in 1887 as part of the *Deutsche Chirurgie*, published by F. Encke. It is the first complete treatise on the subject. The list of publications has been continued as far down as 1888, by E. Burekhardt, of Basel, in his monograph, *Endoscopie und endoscopische Therapie der Krankheiten der Harnröhre u. Blase*, published in 1889; a book full of practical instruction and advice, illustrated by numerous histories of cases and by beautifully executed plates. These are the only books treating entirely on the subject of endoscopy. Among the large number of papers published in periodicals, those of Oberländer, of Dresden, occupy a prominent position, although more of interest to experienced practitioners with the endoscope.

Changes and improvements in the shape and material of the urethral tubes have been devised at different times without material change of the principle of construction. The great progress in the application of the electric light within the last few years has again almost revolutionized the principles of the endoscope, and has furnished us with a number of valuable inventions. There is, therefore, no want of practical instruments; we are rather confronted by an *embarras de richesse* in trying to recommend any one particularly to those who wish to employ endoscopy.

The least complicated instrumentarium is required for Gruenfeld's method, with the light and the reflector separated from the urethral tubes

or sounds, which deservedly form the most important part thereof, and almost entirely usurp the name of the endoscope. From the different instruments recommended by Gruenfeld only one is really necessary. This, the simple endoscope, is a straight cylindrical metallic or hard-rubber

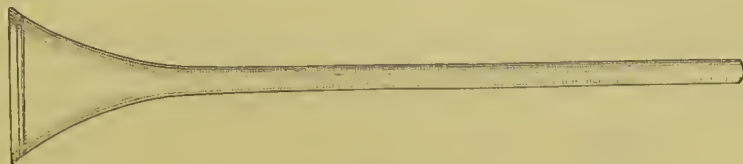


FIG. 1.

tube, cut rectangularly at its visceral end, with a well-rounded and smooth edge; the ocular end widens into a short funnel, the edge of which is rough or indented to afford a firm grip for the finger of the observer. A conductor or obturator, intended to close the visceral end of the tube during its introduction, is formed either of a solid rubber plug, or of a strong wire rod bearing an olive or acorn shaped or cylindrical bulb. It must be well rounded at the top, and well fitted into the end of the tube, so as to bring the shape of the closed instrument as nearly as possible to that of a simple metallic sound or catheter. Gruenfeld's tubes vary from four to thirteen centimetres in length, and from Nos. 14 to 24 of the French scale in width, and are blackened on the inside. An important modification of Gruenfeld's simple endoscope was effected by Steurer, of New York. When the endoscope is introduced to its full length into the urethra, the gradually widening funnel of the ocular end enters the meatus and unduly distends the same, often causing discomfort and pain to the patient. To obviate this, Steurer places a disk between the funnel and the tube proper, by which the glans penis, without stretching of the

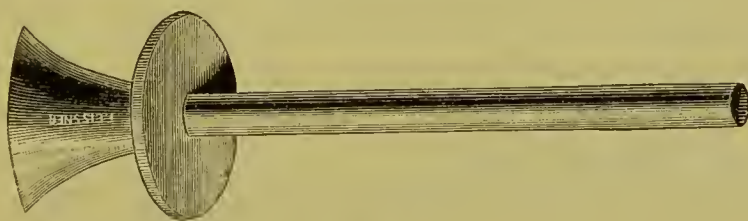


FIG. 2.

meatus, may be shoved back over the tube. Thereby the length of the urethra is reduced considerably, and the deeper portions can be reached with a tube much shorter than the urethra itself. In 1886, after several years' experience with the same, I published a modification of Gruenfeld's, or rather Steurer's, endoscope devised by myself, which since has become well known in the United States as Klotz's endoscope. The funnel-shaped part of the ocular end of Gruenfeld's tube has been entirely dispensed with. Ostensibly intended to facilitate catching of the light-rays, it in-

creases the distance between the eye of the observer and the object by almost one inch, without offering any advantage for increasing the quantity or intensity of the light by deflecting any of the rays, as only nearly parallel rays can reach the end of the tube, eight to thirteen centimetres long.

The tube itself is made of coin silver, in preference to cannulas made of brass or other coarser metals, or of hard rubber, because silver can be

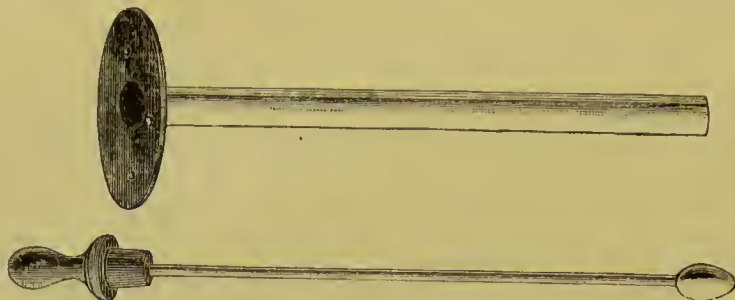


FIG. 3.

worked into much thinner tubes, which, in consequence of the wider bore, furnish a wider field of view for the same size of tube. Besides, silver tubes are much less affected by the chemical action of caustic and astringent solutions, and can be kept much more easily clean and smoothly polished than Gruenfeld's blackened tubes. Auspitz had already been taught by experience that the dissipated reflexes, dreaded so much by others, do not increase in quantity if the inner surface of the tube is always kept clean and smooth, while on the other side in blackened tubes the intensity of the light is greatly impaired by a considerable absorption of light-rays. To avoid annoying reflexes from the surface of the disk, an unpolished hard-rubber plate, one millimetre and a half thick, is riveted to the metallic disk. This is clean, less liable to be injured by chemicals, and insures a firm and comfortable grip, particularly during exploration of the deeper portions of the urethra, wherein the tube has to be held securely and firmly, and to be moved cautiously against the powerful resistance of the muscles. The disk has a diameter of four centimetres, somewhat larger than Steurer's, to prevent overlapping of abundant prepuces. This very light and simple endoscope is extensively used in the United States, and has been recommended by Keyes and Gerster, of New York; Newell and Allen, of Boston; Eversole, of St. Louis; and more recently by S. Alexander and William K. Otis, of New York.

Tubes made of hard rubber have been applied by Weinberg, and later by Schuetz, of Frankfort, who adopted Steurer's disk. They are of very light weight, clean, and can be introduced and advanced without a conductor. To make them strong enough, however, their walls must be of considerable thickness, and the dark inside absorbs much light. Glass

tubes, which had been used already by Butties, of New York, in 1867, have more recently been described by Posner, of Berlin, after the model of Ferguson's vaginal specula, lined with silver and covered with black varnish. They undoubtedly have the advantage of cleanliness, resistance to chemicals, and of excellent light. With Unna, who had previously used glass tubes himself, I consider them too dangerous, on account of the liability to break, particularly if introduced into the deeper portions of the urethra. All tubular endoscopes expose to view at the visceral opening only a small portion of the mucous membrane at one time. By their forward or backward movement gradually other parts come into view, and thus the entire lining may be inspected from the deeper portions to the orifice. To afford inspection of a more continuous strip of the mucous membrane, some bivalved dilating specula have been constructed, which can be distended either at the visceral end alone or in their entire

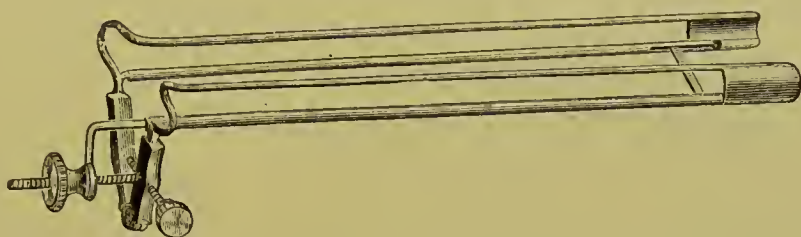


FIG. 4.

length. In 1879 Auspitz placed a dilating speculum before the profession. Meyer, of Berlin (1886), Tuttle (1887), and Tilden Brown, of New York (1888, modified in 1889 and 1891), have described dilatable specula composed of strong wires joined by a metal ring or band at the visceral end. By different screw attachments, or by means of a lever, these specula can be separated independently at the ocular as well as at the vesical end, thus affording equal dilatation for the whole length of the urethra. These dilating instruments are undoubtedly useful for examination of the an-

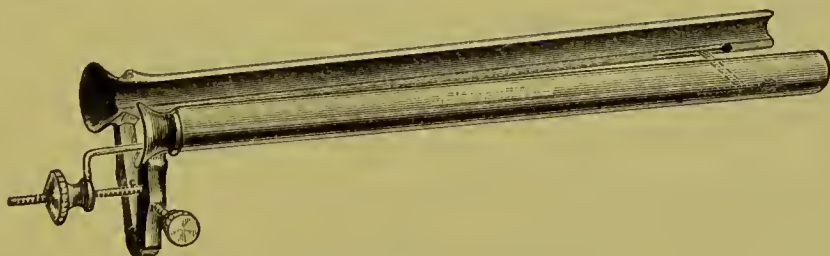


FIG. 5.

terior portion of the urethra. For longer distances the perspective side-long view of an extended stretch of mucous membrane does not give distinct pictures. Besides, the mucous membrane will bulge into the field of view through the intervals between the wire bars and obstruct the

view. The pressure of the branches is sure to affect the appearance of the mucous membrane by rendering it more or less anæmic, while the danger of injuring the mucous membrane by catching it between the branches in closing and removing the instrument is certainly a possibility. The substitution of solid bars for the wire rods, introduced by Brown in his more recent modification, may dispose of the bulging in of the folds. It seems that, while not preferable for common use, the dilating endoscopes may prove of particular value for the isolation of papillary and other growths, and for the demonstration of strictures of wide caliber—a question yet to be decided by further experience.

Von Antal's aëro-urethroscop, and a later similar device by F. Henel, of New York, purpose to distend the urethral walls without a tube by compression of air within the canal, thereby affording an unobstructed continuous exposure of the urethral surface. The impossibility of using these instruments without an assistant, the influence of the pressure of the air on the blood-vessels of the mucous membrane which is rendered more or less anæmic, the restriction of its use to the anterior portion, and the preclusion of the use of any application for cleaning and treating the mucous membrane, deprive this instrument of every claim for general practical use.

With all these endoscopic tubes or sounds the light is thrown into the urethra by a reflector, either attached to a handle or more commonly to a head bandage, so as to leave the right hand of the observer entirely free. A concave mirror of focus length of ten inches, generally used for illumination of the larynx, answers the purpose very well. It affords entire liberty in the selection of the light itself. By far the best light is direct sunlight, and it should always be employed when it can be secured, particularly in the beginning of endoscopic study. A plain mirror attached to the head-band is best used for its reflection, as the concave mirror develops considerable heating effects. Under sunlight the differences in color appear most natural. The configuration of the surface, and dilated and newly formed blood-vessels, can be more readily distinguished than by any other mode of illumination. Sunlight reflected by white clouds, and, under favorable conditions, even diffuse daylight, afford sufficient illumination; but as direct sunlight is unfortunately not always at our disposal, some artificial light is therefore indispensable. Any good kerosene or gas lamp, with argand burner, either alone or in connection with Toboldt's or other light-intensifying apparatus, will answer more or less well. Auer's and Weissbach's incandescent gas-burners with their almost perfectly white light, and, finally, the Edison electric lamp, are particularly serviceable. In the diaphotoscope of Schuetz, of Frankfort, the electric light is employed in a very ingenious manner; it is highly praised by Bureckhardt, who says he has of late used it almost exclusively.

The electric lamp, in the shape of a perforated disk, is placed directly in front of a perforated concave mirror, and is protected by a condensing lens with a dull ground surface; the whole apparatus, inclosed in a metallic case in such a manner that heating is avoided as far as possible, is placed directly in front of the eye, either by means of a handle or a head-bandage, so that the light is placed almost in the eye of the observer. The other instruments for which the electric light has been brought into service, and which naturally recommend themselves to those who enjoy the service of a battery, or can connect the electric lamp with the current from the street furnished by the electric-light companies, are of different construction. A very interesting instrument is Oberländer's electro-urethroscope, recently improved by Kollmann, of Leipsic. Its characteristic feature is the placing of an illuminated platinum-wire loop at the vesical end of the tube in the immediate vicinity of the mucous membrane. The necessity of cooling the tube by a current of cold water, the reduction of the lumen of the tube by the staff bearing the light and the cooling apparatus, the difficulties of making any applications to the diseased portions during illumination, the necessary attention to battery and water-supply, render the instrument, even in its improved shape, rather complicated, although the intensity of the light is certainly very great and the views obtained are very distinct.

Other inventors have united the tube, reflector, and the light into one single piece, returning to the principle of Désormeaux. The best-known representative of this class is Leiter's electro-endoscope (1887). It is recommended as a most serviceable instrument by Finger. A small Edison lamp is placed on top of a handle, through which the wires run, inside of a cover and in front of the concave, slightly inclined mirror. This throws parallel rays of light into the tube to the visceral end. The observer looks from behind and over the mirror into the urethra through a metallic ring into which lenses for correction or magnifying may be inserted. The ocular end of the tube, being unobstructed, is open for the introduction of tampons, brushes, and other instruments—a great advantage over Désormeaux's instrument, and over the electro-urethroscope of Nyrop (1886), which otherwise shows a construction similar to Leiter's. The principal objections to Leiter's instrument are its size and weight. For observation only, it is convenient enough if both hands are at your service, the left hand fixing the penis and the right one directing the instrument by the handle; but when the right hand is needed for cleaning the field of view, or for therapeutic manipulations, it is impossible for the left one to support the penis and the tube with the weight of the optic apparatus attached, and at the same time to effect exact, tender, and subtle handling of the tube which is required for successful examination.

W. K. Otis, of New York, and after him S. Alexander and F. Tilden Brown, reduced Leiter's optic apparatus to a mere skeleton and its weight to one sixth of the original, which with aluminium as material might still be reduced. A small concave mirror is connected by a stout

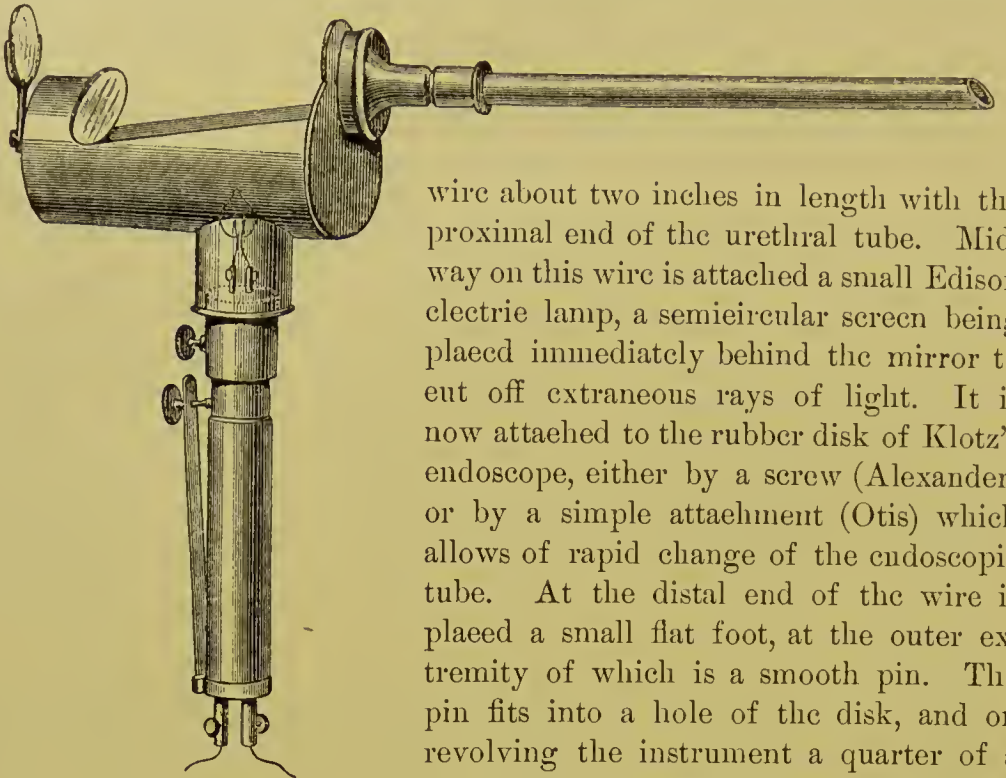


FIG. 6.

wire about two inches in length with the proximal end of the urethral tube. Midway on this wire is attached a small Edison electric lamp, a semicircular screen being placed immediately behind the mirror to cut off extraneous rays of light. It is now attached to the rubber disk of Klotz's endoscope, either by a screw (Alexander) or by a simple attachment (Otis) which allows of rapid change of the endoscopic tube. At the distal end of the wire is placed a small flat foot, at the outer extremity of which is a smooth pin. The pin fits into a hole of the disk, and on revolving the instrument a quarter of a circle the foot swings under a shoulder riveted to the plate and securely fastened.

Brown has connected the same apparatus with his bivalve speculum. In this reduced form the electro-endoscope certainly recommends itself as extremely simple and practical. It must be acknowledged that it is an advantage of the instruments in which tube, reflector, and light are joined in one piece, that the illumination and possibility of inspection of a certain region are assured at once as soon as the instrument is introduced, and will remain so regardless of changes in the position of the observer or of the patient. With the head-mirror the focus of light-rays has first to be directed into the tube and on the desired spot of the urethra. A precise position of the head is therefore exacted, and the accommodation of the same to the changes in the position of the object as well as the observer. Sufficient dexterity in directing the light, unless previously gained from laryngological studies, is, however, easily acquired by practice, and if once acquired affords ample compensation by enabling the observer, by a slight movement of the head, to change the intensity of the light and to focus the rays much more nicely on important points so as to bring out the differences in the surface of the mu-

eous membrane. This can not be effected with an instrument in which the distance between the light and the visceral end of the endoscopic tube is a fixed one, and tubes of uniform length, therefore, have to be employed, while with the mirror, endoscopes with any desired length can be used. F. T. Brown has tried to eliminate from Otis's endoscope this disadvantage by making the speculum movable along the bar which bears the electric lamp. Perhaps it would be more advantageous to make the lamp itself slide upon the horizontal bar which connects the mirror and the tube.

Endoscopic Armamentarium.—Whatever method of endoscopic examination may be selected, and whichever illuminating apparatus, it will be necessary to have several urethral tubes of different caliber, and, whenever practicable, of different lengths. It is obvious that in general, *cæteris paribus*, the intensity of the light and the distinctness of the picture received by the eye of the observer will increase in proportion with the width and decrease with the length of the tube. As a rule, therefore, the largest caliber that passes the meatus ought to be employed, and the shortest tube that will reach to the spot which it is intended to examine. While there is really little difference in the length of the urethra, the length of the pendulous portion of the penis, and the development of the connective-tissue framework of the same vary considerably in different individuals. In most cases an instrument four inches in length will be sufficient to reach the membranous portion by shoving back the penis with the disk, but for demonstration of the prostatic portion instruments of five or five and a half inches are preferable. In particular cases I have had constructed tubes six and a half inches long, to get a view near the external orifice of the bladder. Tubes under No. 23, French scale, even if only two and a half to three inches long, are of very little use. To those who have had some experience with endoscopy, they may occasionally be of good service for reconnoitering the forward portions of the urethra, and to prove the absence of certain conditions, like warts, ulcers, etc.: but to get an insight into the condition of the mucous lining and of the submucous tissue, it requires tubes from 24, French, upward, increasing in length with the caliber. A set of endoscopic tubes—No. 23, 3 inches long; No. 24, $4\frac{1}{2}$ inches long; No. 26, $4\frac{1}{2}$ to $5\frac{1}{2}$ inches long; No. 28, $5\frac{1}{2}$ inches long; No. 30, 4 to $5\frac{1}{2}$ inches long; and perhaps one No. 32, $5\frac{1}{2}$ inches long—will probably be sufficient for all practical purposes.

Besides, a number of auxiliary instruments will be needed for the successful application of the endoscope to diagnosis and treatment—a number of tampon-holders, better not fewer than twenty, for cleaning the surface of the mucous membrane of adherent grease, pus, mucus, blood, or other substances, and for applying drugs in solution or in pow-

der form. Pieces of cylindrical wood such as used in preparing matches, cut into convenient length, are sufficiently rough to hold tufts or wads of absorbent cotton after a few turns around their axis. They may be armed with tampons at both ends and thrown away after use. Strong wire rods of galvanized wire, brass, or German silver, bent at one end into a ring to serve as a handle, and filed sufficiently rough or bearing a number of turns of a shallow screw, are equally serviceable, and can be used again after removal of the soiled tampons. The tufts or tampons themselves ought to be of different sizes for the different sizes of tubes and according to the extent of the spot to which they are to be applied. The plain rods are preferable to more complicated pineer-like instruments, to which a cotton tuft is fastened by a ring. Occasionally the tampons get loose from the rods and remain in the tube, but usually can be removed without difficulty by the rough end of the wire, or, better still, by a wire drawn out into a fine corkscrew. For the application of medicine, the cotton tampons are preferable to pencils or hair-brushes, because they are always clean, absorb sufficient fluid to communicate it to that portion of the mucous membrane with which they are brought into contact, but do not allow of the falling of a drop on the mucous surface, which would be liable to prolong the effect of the drug longer than is desirable, or to carry it to portions for which its application was not intended and might do harm. Besides, brushes and pencils have to be cleaned at every application, are liable to spoil solutions of metallic salts into which they are inserted, and themselves become easily brittle, hard, or sticky. Powders can easily be carried to any desired spot by the same cotton tampons, but an insufflator, or a tube for blowing finely powdered drugs on the desired spots, may be employed, as recommended by Gruenfeld and Burekhardt. Naturally, almost any apparatus for the insufflation of powders or for the spraying of fluid drugs may be adapted to the needs of the endoscope. Solid caustics, like nitrate of silver, sulphate of copper, etc., are applied by means of porte-caustics, which differ only by their more slender and longer stem from those used for ordinary purposes. A fine eurette, ring or spoon shaped, and several probes of different caliber, are, if not absolutely necessary, still very desirable additions to the endoscopic armamentarium. Several minute knives of different shape, pointed, curved, and blunt-pointed; scissors, straight and curved, and forceps, may be required occasionally, as well as a wire snare for the removal of new growths.

- Burekhardt has largely used the galvano-cautery and devised different-shaped electrodes—a fine-pointed cautery for scarification, one with a flattened point, and a broad, knife-shaped one. It need hardly be mentioned that all the instruments just enumerated must have handles of sufficient length to pass through the longest of the endoscopic tubes, de-

manding a length for the entire instrument of from seven to eight inches. It is further desirable, but not absolutely necessary, that the proximal end of all the instruments be bent under a right or obtuse angle, so as to allow of the inspection of the urethra during application. For the cotton tampons it is entirely superfluous.

Special tables for endoscopic examination have been designed by Finger and others, but any surgical chair or table that can be raised to a height of thirty-eight or forty inches will be serviceable. The individual to be examined assumes a reclining position. The upper part of the body may be slightly elevated, the buttocks drawn down as far as possible toward the edge of the seat, the knees and feet well separated so as to allow sufficient room for the observer, the feet resting on some support either connected with the table or on a small chair, or on the front round of a common cane-seat chair occupied by the observer. In this way it is possible to go over the entire length of the urethra without change of position; only, to lower the ocular end sufficiently to reach the deepest portions of the urethra, it occasionally becomes necessary to relinquish the seat and to kneel in front of the chair or table. If the observer begins the examination while standing, he has to change his position on reaching the membranous and prostatic portions. When a reflector is used, the light is placed on one side of the patient, generally the right, on a small table, which also affords a place for cotton tampons and other instruments, unless a shelf on the chair is provided for. Where the light is connected with the tube greater freedom is allowed for the position. It has already been mentioned incidentally that, as a rule, the examination of the urethra is performed backward from the distal end of the organ; with hard-rubber tubes, and, to a certain extent, with silver tubes it is possible to pass inward from the orifice and inspect the interior while progressing; but in most cases it is easier to introduce the tube with an obturator to the deepest portion which it is desired to inspect, and, after removal of the same, to view that portion which presents itself in front of the straight visceral end of the instrument. During gradual withdrawal the tube will pass every point of the mucous lining, and so bring into view, bit by bit, the entire interior surface.

Method of Examination.—To proceed with the endoscopic examination: Having put your patient, light, medicines, and instruments in the right position, the proper size of endoscopic tube selected, this has to be thinly covered in its entire length with some greasy substance—vaseline, with or without boric acid, or some other unirritating disinfectant, being preferable to glycerin. Now the left hand takes hold of the penis, brings it to angle of about 90° with the abdomen, grasping the glans between the thumb and index-finger and opening the lips of the meatus, while with the right hand, the thumb pressed against the top of the

handle of the obturator, the second and third finger resting on the edge of the disk, passes the point between the lips, and, feeling its way along the upper wall of the urethra, moves it gently downward until the disk comes in contact with the glans or resistance is felt. In the first case, under somewhat increased pressure, the disk pushes the penis until the end meets with resistance. The bulb of the obturator is now touching the bulbous portion. If it is not intended to inspect more than the anterior urethra, the left hand takes hold of the disk between the thumb and index-finger while the third and fourth fingers support the penis between them; the right hand removes the obturator. If, however, it is intended to examine the entire urethra, the ocular end of the tube is now gradually lowered to a horizontal line, and while being gently pushed on, and then more or less below the horizontal line, until the end of the tube glides on toward the bladder—as a rule, the most painful part of the operation. While the resistance of the external sphincter is rarely very strong, in my experience that of the internal sphincter is very firm, so that even with a sufficiently long instrument it requires a great effort to pass into the bladder. The difficulties in passing beneath the arch of the symphysis vary considerably in different individuals, owing to the difference in the insertion and length of the ligamentum suspensorium penis. Sometimes it is hardly necessary to lower the ocular end of the tube below the horizontal line; sometimes it must be turned almost into a vertical line. In very few instances I found it impossible, even with a small tube, to enter beyond the membranous portion. The end of the tube always turned against the upper wall and was caught by the symphysis, while curved sounds would easily pass around the obstacle. The deepest possible point being reached, the left hand, which now has to contend with all the force of the muscular apparatus which brings strong efforts into play to throw out the instrument, takes firm hold of the disk, the obturator is now removed, and the examination proper begins.

Usually the field of view is covered by some fluid—a mixture of vaseline, mucus, and other secretions of the urethra and of its glands—and has to be cleaned by gentle touch with a dry cotton tampon. This cleaning process has to be continued more or less through the entire urethra. Small quantities of blood can easily be wiped off, but whenever a more serious hæmorrhage takes place the examination has to be given up, at least for the portion of the urethra where it occurs. After inspection, a slight retrograde movement of the tube commences to bring other portions before the visceral end. This movement has to be directed as far as possible in the axis of the urethra, and therefore has to follow the natural curve of the deeper urethra through the horizontal line until the ocular end has again turned upward. As long as this presses against the glans penis and shortens the urethra, it is sufficient to take hold of the

disk or the proximal end of the urethral tube alone; but as soon as the tube passes out of the urethra it is necessary to take hold of the penis itself with the last three fingers, to prevent too rapid motion and the slipping off of the penis from the tube. The thumb and index-finger then gradually pass from the disk to the tube itself, until the visceral end glides out of the meatus. During observation alone the right hand may assume the leading out of the tube, thereby assuring greater accuracy and steadiness, while the left one supports the penis and takes control of the tube only when the right one is engaged in cleaning the surface or in other manipulations. Meanwhile the light from the reflector has been directed through the tube on the exposed portions of the surface, and the observer has had a passing view of every part of the interior.

The Endoscopic Picture.—The pictures which present themselves to the eye vary considerably according to the different portions of the urethra. Around the edge of the tube the folds of the mucous membrane, into which it is formed during the natural condition of rest, will be fully extended into a smooth ring. Owing to the natural elasticity, the walls of the urethra have the tendency to collapse again into their former position, and will converge as soon as relieved from the distending pressure of the tube. The surface, therefore, assumes the shape of an inverted cone or of a funnel; at a short distance from the edge of the tube the natural folds of the mucous membrane begin to appear again, and, gradually increasing in height, run together like the folds of a paper filter, reducing the lumen of the urethra into a point or a short line which has been called the central figure (*Centralfigur*) by Gruenfeld. The form of the funnel largely depends upon the degree of pressure with which the tube is held against the urethral wall. If pressed firmly forward the mucous membrane will bulge into the lumen of the tube. During moderate pressure it will rest flat in front of the vesical opening, and on diminishing the pressure, or on gentle withdrawal, the surface will recede from the edge of the tube and form a funnel or cone. The more exactly the urethral tube is adapted to the size of the urethra, the smoother will be the surface of the funnel and the more slowly will the folds appear, while the mucous membrane will bulge into larger and wider folds whenever the tube fits loosely in the urethral lumen. The natural condition of the surrounding tissue will likewise influence the shape of the funnel, as well as certain configurations of the urethra itself.

Appearance of the Urethra.—The healthy mucous membrane shows a more or less pale pink or red color, quite often longitudinal stripes of lighter shade, and a moist, glistening surface, giving the appearance of a soft, dull, silky tissue, greatly resembling the mucous membrane of the oral cavity. The moist and smooth surface reflects the light thrown upon it in manifold shape, every irregularity becoming apparent through breaks

or altered shape of the reflexes. Gruenfeld has attached great significance to these reflexes by studying them minutely, and drawing from them conclusions as to the condition of the mucous membrane. Indeed, in reading his book one becomes impressed with the idea that it is impossible to obtain a direct view of the objects, but only indirect knowledge of their condition by observation and interpretation of the reflexes. With narrow blackened tubes, which Gruenfeld persists in using, this is indeed the case, but with sufficiently large and polished tubes and good lights, as Posner has bluntly pointed out, we can simply and directly see the condition of the surface. Therefore, instead of studying the reflexes, they are rather to be avoided, and when they appear the position of the tube is to be changed a little, whereupon they will disappear. In the central position of the endoscopic tube, that is following strictly the axis of the urethra, these reflexes occur more frequently. While this method is more favorable for summary exploration, and is essential for demonstration of the changes in the elasticity of the mucous and submucous tissue, for the study of the surface of the membrane and the lacunæ Morgagni, irregularities of the epithelial covering, etc., the eccentric position of the vesical end of the tube is much more preferable. By turning the proximal end to the right or left, above or below, the distal end will cover a portion of the interior of the mucous lining, and present it perfectly flat and level to the eye. By withdrawing the tube in slight spiral movements, the entire inside may be gradually unfolded and pass before the eye like a panorama, and allow of the closest observation of every irregularity.

Beginning now at the inner end of the urethra, at the prostatic portion beyond the colliculus seminalis, the mucous membrane forms a very flat cone of decidedly red color, molded into a number of sharply defined low folds which radiate toward the somewhat eccentrically placed lumen of the internal orifice. On starting the outward movement the flat cone or funnel begins to be slightly deeper, while the folds flatten and the color gets paler. Further on, sometimes gradually, sometimes quite suddenly, a more or less flat, rounded protuberance appears above the lower edge of the tube, somewhat paler, as a rule, than the surrounding portions, and with decided longitudinal stripes. This gradually gains in width and height until the lumen of the urethra appears semilunar. This is the colliculus seminalis. On further advance the protuberance ends abruptly, or gradually thins out into a small pointed ridge (*caput gallinaginis*), which sometimes can be followed as far as the bulbous. In the center of the colliculus quite often a small longitudinal slit or indentation can be distinctly seen, covered with clear, mucus-like fluid, leading into the so-called uterus masculinus. Where the colliculus appears more broad and ribbon-like, it passes gradually into the lateral portions of the mucous mem-

brane, where it is more elevated and narrow, deep furrows are formed on both sides with a somewhat darker red, uneven surface. It is not possible to distinguish with any certainty the openings of the ductus ejaculatorii, or prostatic-gland ducts, which are located there, and sometimes manifest their presence by the sudden flooding of the field of view with a watery fluid. It is not always possible to keep the tube strictly in the axis of the urethra; it may then happen that only one side of the colliculus with the adjoining groove is seen, or that the tube passes through one of these lateral grooves, and the colliculus is turned toward one side and does not come into view at all. Altogether there reigns great individual variety in the configuration of this extremely complicated region, which with our present knowledge of the pathological conditions may render it very difficult to draw the line between normal and diseased conditions. It has happened that the colliculus was mistaken for a polyp. Occasionally two rounded folds of mucous membrane of a dark-red color bulge in from both sides like curtains over the whitish point of the caput gallinaginis, forming a triangular lumen or central figure.

Reaching the membranous portion, the mucous membrane now assumes a somewhat lighter color; the funnel becomes regular; radial folds unite in one point or into a short vertical slit. The transit from the membranous portion into the bulbous may be very gradual, without a remarkable change of the color or of the shape of the folds. More often, however, the funnel appears less deep, and divides into several large, somewhat bulging folds. According to Finger, the progress into the bulbous portion is marked by a sudden jerk, the funnel disappears, and two large folds of mucous membrane cover the end of the tube. This is indeed occasionally observed in cases where the bulbous really forms a bag-like dilatation of the urethra. This formation, which is often depicted in anatomical demonstrations of the urethra, does not really exist in the larger number of cases. In the cavernous portion the color of the mucous membrane is of lighter pink, often with fine white stripes. It presents itself as a regular funnel or cone, divided into several more or less wide folds, and uniting in a horizontal slit as a central figure, which is often divided at both ends by broader lateral folds into two small vertical slits. The natural shape of the lumen of the urethra explains the horizontal figure which is maintained until near the glans. It then changes into a triangular form, to become a broad vertical slit between the rigid walls of the so-called fossa navicularis. As with the bulbous, it is often found that the assumed widening of the urethra within the glans does not really exist, but that the appearance of a cavity is solely due to the fact that the rigid urethral walls do not collapse like in the deeper portions. The color of the mucous membrane gradually assumes a more whitish tint, which within the glans turns into a yellowish or bluish one. The surface is generally

smooth. Along the upper aspect the lacunæ Morgagni may become visible as very fine indentations, as if made with a pin, or very shallow impressions with a sharp, smooth edge. Dark-red lacunæ surrounded by a distinct red ring, as described by Finger and Burekhardt, I can not acknowledge to be a normal condition. In the bulbous and cavernous portion the endoscopic examination will hardly cause any bleeding in the normal condition, but in the membranous and prostatic portion even the most careful handling of the instrument may cause slight hæmorrhages, even in the absence of pathological changes. As a rule, very slight lesions heal without any difficulty, and do not cause any evil consequences.

It is obvious that if the urethra in its normal state can thus be inspected with the endoscope, the same can be done under pathological conditions, and that we are enabled to gain certain knowledge of the nature and seat of the pathological changes. It has been claimed that such knowledge can be obtained by other means, and that therefore the endoscope is not necessary for diagnosis. It is true that a great deal of knowledge can be acquired by examination of the urethra through the sense of touch, but not even the subtle dexterity of the most experienced surgeon's hand will unravel some conditions, and doubts and errors will occur. The difficulties which present themselves to the effective treatment and definite cure of some affections of the urethra, particularly to the suppression of chronic discharges, and the frequency of these ailments, bear ample testimony to the inefficiency of these means. Many patients can be found who have had their chronic gonorrhœa treated by internal medicines, by the usual injections administered by themselves, by deep injections made by the surgeon, by irrigation, by sounds, and even by an abundant urethrotomy, and who still have a mucous or purulent discharge. In such cases the presence of numerous filaments in the urine makes the existence of some pathological condition almost a certainty, and the desire to look into the urethra and find the cause of the continuous discharge is but natural, and is justified by the fact that in the greater number of cases pathological conditions are easily found. However, in subjecting patients to endoscopic examination great precautions have to be taken. During the stage of acute, and even of subacute inflammation, the endoscope ought not to be applied.

Gruenfeld and other authors have described the appearance of the urethra in its different stages of acute gonorrhœal urethritis, but neither have any practical results been obtained, nor can the introduction of the endoscope in such conditions be considered harmless. Exceptionally an inspection may be justified through a tube of small caliber, where the presence of an ulcer or of a new growth is suspected; but as a rule no endoscopic examination ought to be made until the symptoms and exami-

nation by other means make it probable or certain that the pathological condition does not extend over the entire length of the mucous lining, but is restricted to some more or less circumscribed portions.

The advice of Finger, to abstain from instrumental examination as long as there exists a copious mucous cloudiness of the urine in connection with the gonorrhœal filaments, may safely be followed. Tarnowsky's rule, adopted by Finger, not to examine a patient with the endoscope until by repeated introduction of metallic sounds it has become somewhat accustomed to the passage of instruments, seems to go too far.

Burkhardt advises beginning the first examination by the introduction of an elastic *bougie-à-boule*, to be followed by a big metallic sound. It is certainly necessary, unless the history of the patient reveals that sounds of a certain size have been passed within a certain time, to ascertain the caliber and sensitiveness of the patient's urethra by such means. But unless delay is, for some reason or other, out of the question, it is preferable not to let the endoscopic examination follow immediately, but to defer it for one or several days.

If the meatus does not admit easily a tube of at least No. 23, French scale, it must be enlarged in the usual manner. It has been advised by several authors to experiment on the cadaver before trying to use the endoscope on the living. Aside from the impracticability of this rule, the appearance of the mucous membrane on the cadaver differs so much from that on the living that comparison between the two is hardly of any value, and the difficulties met with in the introduction of instruments into the living urethra are entirely different from those on the dead. It must be distinctly understood, however, that nobody ought to undertake to use the endoscope until he is thoroughly acquainted with the anatomy of the urethra, and possesses some experience in the introduction of solid sounds and catheters on the living. The difficulties connected with the use of the straight instrument, against those with the curved one, have often been overestimated. The hand that knows how to tenderly guide the sound rather than push it will have no great difficulty with the straight endoscopic tubes. The first introduction of the endoscope is usually somewhat painful. The use of cocaine ought to be avoided, unless the sensitiveness of the patient makes it absolutely indispensable, on account of the contraction of blood-vessels and the consequent change in the color of the mucous membrane, at least under the influence of stronger solutions. A five-per-cent solution does not cause material alteration, and is sufficiently strong to make the procedure bearable. In subsequent sittings cocaine may be used. Most patients, however, become used to the endoscope quite readily, and will not need it.

While it is the rule to use the largest possible caliber of endoscopic tubes, it may be more judicious to be content with a smaller number dur-

ing the first examination, so as to make the first experience with the somewhat startling procedure as easy as possible. For the same reason it has been advised, and correctly so, not to extend the first sitting beyond the bulbous or the membranous portion, and to be satisfied with a more cursory and superficial inspection, leaving a more minute exploration to the future.

Opinions are divided on the advisability of having the bladder emptied a short time or immediately before the examination. The retention of the urine, aside from the danger of its suddenly entering the tube, undoubtedly increases the discomfort of the patient during the examination and afterward, because he will be obliged to pass it soon after the operation, when the urethra is always more or less sensitive. The advantage of locating spots on which filaments and other secretions are formed is in reality often frustrated by the removal of the filaments by the rim of the tube during introduction. Where therapeutic measures are intended, it is particularly advisable to avoid early micturition after the operation in order to allow of the longer undisturbed action of the drugs on the mucous membrane. Besides, the cleaning of the surface by the stream of urine renders the removal of the secretions by means of cotton tampons more or less unnecessary.

The rules and conditions for the examination of the urethra in persons affected with disease are exactly the same as for the normal urethra, but the mucous membrane will present to the eye modifications from the normal condition in great variety and in numerous combinations, so that one meets with great difficulty in trying to arrange them in definite groups. Unfortunately, our knowledge of the histological conditions of the urethral tissue has been and is very incomplete, but recently Neelsen and Finger, by a number of methodical examinations of cadavers, have studied the changes of the tissue of the urethra. Although the lack of opportunity to examine the same portions during life and after death leaves some doubt about the interpretation of certain conditions, it must also be stated that the extent and the nature of the lesions found in chronic gonorrhœa are by no means always proportionate to the intensity of the preceding acute inflammation. Sometimes considerable alterations are found where at no time more than a very slight discharge had existed, and but insignificant impairment is found after a rather long-continued profuse running.

In general, endoscopy has proved the erroneousness of some doctrines which have been proclaimed over and over in text-books. The regions pointed out spontaneously by patients as sensitive or particularly tender on the touch of a *bougie-à-boule* are by no means always the seat of pathological conditions, but more frequently are found in healthy condition. Nor is it confirmed that the posterior parts of the pendulous

urethra, the bulbous and membranous portions, are usually or even more frequently affected in chronic urethritis, as has been maintained.

It appears, on the contrary, that in by far the greater number of cases the anterior and central portions are the regions principally affected; that sometimes the two inches nearest the meatus alone are diseased. Among one hundred cases, I found the seat of the morbid changes to be the prostatic and membranous portion alone in five cases; the prostatic and spongy alone in two; the prostatic, membranous, and spongy in twenty-two; the membranous and spongy alone in twenty-six; and the spongy portion alone in forty-five cases. The prostatic portion was affected in twenty-nine, the membranous in fifty-three, the spongy in ninety-five cases, the bulbous especially in forty-four cases. This agrees very well with Finger's examinations on the cadaver, who, out of thirty-one cases, found the pendulous portion affected in twenty-two. Out of twenty-four cases relating to the pendulous or membranous urethra only, in seventeen the spongy portion alone was the seat of localized changes.

Pathological Appearances.—The impairment of the normal condition of the urethra may pertain to the color of the mucous membrane, to the character of its surface, and to the volume and elasticity of the entire urethral wall, which determines the shape of the funnel and of the folds in the endoscopic pictures. An œdematous, succulent condition of the mucous membrane is characterized by a reduction of the lumen of the funnel in every direction. It seems flat and narrow; the edge of the tube forms a sharp impression, which disappears slowly on removal of the instrument. In a very high degree of swelling the funnel is entirely obliterated, and the mucous membrane bulges into the tube itself. In all such cases the movements of the tube are followed rapidly by changes in the folds as in a kaleidoscope. In other cases this transformation proceeds more slowly. The receding edge of the tube does not leave an impression; the folds form more sluggishly, owing to the firmer swelling or infiltration of the mucous membrane. It, however, retains its elasticity, and does not offer any obstruction to the tube. Again, we find that the wall clings more tightly to the tube, and on its withdrawal does not collapse immediately nor fold itself, but forms a deep, sharply pointed funnel with rather patulous infundibulum and rigid sides. This sclerotic condition may be found limited in extent or affecting almost the entire urethra, showing either a perfectly smooth but almost white, tendon-like appearance, or more or less natural red color, which, however, on pressure gives way to a whitish, ivory-like shade. This diffuse hardening of the entire urethra, which has been described occasionally but without attracting much attention, must not be confounded with stricture. It ought to be designated by a distinct name, like diffuse sclerosis, or otherwise. This different configuration is due to

the different degree of infiltration which, according to Finger, may be confined to the subepithelial layer, or may reach deeper into the mucous membrane, into the submucous and cellular tissue, and even into the cavernous tissue, in the latter case leading to retraction and stricture. Sometimes the infiltration does not affect the entire circumference of the urethra. The funnel, and with it the central figure, appear irregular, occasionally one fold dropping before the lumen of the tube quite suddenly like a curtain. It is impossible, however, to follow up all these details.

Higher degrees of infiltration, which cause the condition generally described as stricture, render the introduction of a tube impossible. It may, however, be pushed as far as the obstruction, and furnish a view of the configuration of the stricture. Sometimes it has become possible, by exposing the front of so-called impermeable strictures, to pass a whalebone filiform bougie into the very small, often eccentrically situated lumen through the stricture, and, by introducing a tunneled catheter over the bougie, to open the stricture to further dilating treatment. In strictures of wide caliber the endoscope will furnish valuable information according to the extent and the degree of hardening of the tissue; in other cases the endoscope may be the means of demonstrating the spasmodic nature of strictures by the absence of all organic alterations of the seat of the supposed stricture.

In the face of the often-made assertion that chronic urethritis inevitably tends to the production of infiltration of the submucous tissue, I must state that, in quite a number of cases of very long standing gonorrhœal discharge, extending to eight and ten years, I have observed over and over again normal folds and the normal softness of the mucous membrane. Much more conspicuous than the changes of elasticity are those of the color of the mucous membrane. The natural pink may give way to all shades, from the pure glistening white of a tendon to deep scarlet, to darker shades of bluish and brownish red, or to slate color. These different tints may extend continuously over a large area, or may be restricted to spots or patches, or not rarely to radiating or longitudinal stripes. In considering the diagnostic value of these changes of the color, account has to be taken of individual differences, distant psychical or nervous reflexes, and of the immediate mechanical effect of the instrument. Sometimes the dull luster of the healthy mucous membrane gives way to a more perfect glistening smoothness of oedematous tissue. At other times it appears more shiny, like satin, or even as if varnished. More often, however, the surface loses its soft smoothness and appears rough, like the inside of undressed kid or thin leather. These conditions, which appear in great variety, seem to depend on pathological changes, and very often on the new formation of networks of blood-vessels, which, particularly in reflected sunlight, can be clearly distinguished.

In other cases the surface appears like velvet, with minute pointed eminences; frequently alterations appear in the shape of more or less white longitudinal stripes, as a rule representing the ridges between folds. Sometimes the normal, sometimes the morbid portions are prominent, giving the appearance of smooth or uneven ridges. Again, the longitudinal or radiating prominences slightly project, with a perfectly smooth epithelial cover, apparently circumscribed subepithelial infiltration. Of more frequent occurrence are more or less circumscribed and disseminated granular patches. The dark-red, uneven surface is broken by elevations of the size of a rape or millet seed, or smaller, which are placed more or less closely together, leaving between them depressions of a deeper, more brownish tinge, and reflecting the light in the shape of numerous points. It is not unlikely, from Finger's observations, that the granular projections are due to considerably dilated blood-vessels rather than to the mucous glands or a papillary construction of the mucous membrane. The great tendency of granular patches to bleed on being touched even lightly would then be easily explained. Granulations have been described by all authors from the earliest days of endoscopy as almost regularly associated with chronic urethritis. From my own experience I can not share this view. The conditions which strictly answer to the so-called granular state are not of so common occurrence. While observing them in almost every part of the urethra, I have found granulations quite frequently associated with affections of the lacunæ Morgagni, which I have found in not fewer than sixty-three out of one hundred cases.

Sometimes on the first examination, sometimes after the swelling of the mucous membrane has been somewhat reduced by treatment, do these lacunæ appear as more or less sharply defined round or oval pits or depressions of the size of a small pin-head to that of a hemp-seed, and quite often covered by a drop of sticky mucous fluid. The edges now appear rough, as if eroded, now smooth and sharply cut; often their proximal end is covered by a semilunar fold or duplication of the epithelium of the mucous membrane; again they appear as slightly elevated craters. The lacunæ are most numerous distributed along the upper aspect of the central portion of the urethra, extending frequently to the lateral corners, which are formed by the meeting of the upper and lower walls of the urethra during natural rest, and sometimes on the lower surface. A particularly well-developed lacuna magna with a sharp semilunar edge is frequently found within or near the fossa navicularis. It is not unusual to observe sharply cut notches or notches within the perfectly smooth mucous membrane. On extending them by lateral position of the tube and sufficient pressure, these notches may be developed and reveal at the bottom widened lacunæ. Finger's pathological investigations confirm the

frequent participation and the important part assumed by the *laeunæ Morgagni* in chronic inflammation of the urethra.

In the lateral corners of the pendulous portions well-defined patches of irregular shape and size, of dark-red or brownish color, and of a dry, finely corroded surface, are not infrequently observed, which, on being touched with Lugol's solution, assume a dark-brown or almost black tint, which makes them vividly contrast with the surrounding normal and smooth portions of the mucous membrane which are not affected by the application of the iodine. Whether this reaction is due to the formation of amyloid tissue, or to changes in the epithelium from cylindrical to pavement cells, I am unable to say.

The occurrence of almost transparent sago-like grains or corns, imbedded in the intumescient mucous membrane, as in trachoma, has been mentioned by several authors. I can confirm the existence of such forms from one single but well-observed case. Circumscribed, mostly slightly elevated, perfectly white, and rather firm patches, rarely exceeding one third of an inch in length, are occasionally seen in different portions of the urethra. Gruenfeld has described them as the formation of new layers of epithelium (*Epithelaufagerung*), which opinion is borne out by Finger. A change of the nature of the epithelium is most likely connected with the thickening. Sometimes small, deepened white spots are noticed, which look somewhat like sears. It is necessary to mention here sears formed by internal urethrotomy, appearing almost always along the upper aspect of the urethra as perfectly white, more or less deep and wide furrows, extending only over a short space, but occasionally over the entire length of the pendulous urethra. Occasionally, two or three months after the operation, these furrows were found yet unhealed at the bottom. Even if perfectly smoothly healed, deep persisting furrows or sears may remain the seat of the formation of filaments.

Loss of substance is much less frequently found than new formation or thickening. More generally the defects do not extend deeper than the epithelial covering. Such spots appear somewhat depressed, yellowish, without luster, and are very sensitive to the touch. They were found mostly in persons of very nervous habits. Small, well-defined spots, not larger than hemp-seed, and forming a group, with a red surface and deeper colored edge, have been occasionally observed, closely resembling groups of herpes on other mucous membranes. Deeper defects of the mucous membrane, and ulcers bearing the characters of so-called chancreoid, have been described. They usually are found near the meatus, where the initial lesions of syphilis are likely to occur.

Better observed are the tumors of the urethra, which occur either as warts or as mucous polypi. The former are frequently found directly within the meatus, often in company with the common venereal warts

around the frenum and sulcus coronarius. Less often they are found in larger numbers extending into deeper portions, mostly grouped to one or a few larger conglomerates, or studding the surface as numerous disseminated smaller excrescences of most grotesque shapes. They may attain the size of a pea, with a broader base, or consist of single elongated papillæ with slender stems. They come into view rather suddenly, rising above the edge of the tube as soon as relieved from its pressure, and on further withdrawal new groups come into view. They are generally of very light color, the extreme papillary prominence almost white or transparent, and are easily recognized from their irregular shape. As the mucous membrane normally shows a papillary structure only for a short distance from the meatus, it is difficult to explain their occurrence in the deeper portions, as far as the membranous urethra.

The larger smooth polypi, which are generally found in the deeper urethra, as far as the prostatic portion, likewise appear suddenly before the end of the tube as smooth rounded bodies of bluish color, somewhat transparent on the circumference, according to their size, covering more or less the entire field, or protruding from the edge. On touching them with a probe they are found to be soft and generally movable, and can be passed around, but do not bleed easily. Smaller ones may be brought into view in their totality. Larger ones may require several movements of the tube to demonstrate their volume. It is always necessary, by different manipulations from side to side, to bring the entire polyp within the lumen of the tube, so that its insertion may be determined upon. They may have a comparatively thin stem or grow from a broader base. In the membranous portion I have repeatedly found new growth of decidedly more fibrous or even of elastic structure. They were always elongated, some very small ones sharply pointed. A larger one, nearly one inch in length, protruded from the membranous portion into the bulbous, and, like the others, grew from the lower surface. It is probable that they owe their elongated shape and forward direction to compression by the muscles of the membranous portion, and to the force of the outstreaming urine.

The different pathological conditions just described may vary greatly as to distribution over the different portions of the urethra. Although they all may occur in different regions, certain forms show a decided preference for certain localities, like the enlargement of the lacunæ Morgagni, papillary excrescences, etc. Granular patches may be found all over. The prostatic portion may exhibit some peculiarities owing to its complicated formation, the changes pertaining principally to the *colliculus seminalis*. A great tendency to more or less profuse bleeding makes it often very difficult to judge of the true condition of these parts. The *colliculus* may be found considerably enlarged, often occupying the entire

lumen of the tube, of a decidedly darker red color, without the smooth striped surface. On account of the succulence of the tissue, the opening of the sinus prostaticus can not be distinguished. According to Burckhardt, who has studied the pathological changes of the prostatic portion more than any one else, in cases of spermatorrhœa the opening of the sinus was more patulous, admitting a probe to a considerable depth, while the colliculus was enlarged, but showed no loss of elasticity.

In the face of such great variety of symptoms, the temptation to arrange them into separate groups and to differentiate several species of chronic urethritis is very great, and, indeed, since Désormeaux has been attempted by almost every author. Oberländer, more than any one else, has endeavored to create a systematic division and subdivision of the various forms of chronic urethritis, founded on their pathological alteration. However, the different conditions are found side by side at the same time in the same urethra, and at the same localities at different times, so that they really represent only various phases and various stages of development of the same process. It is therefore not advisable to complicate matters by the adoption of separate forms and names—certainly not as long as many questions are still awaiting solution from further microscopic investigations.

Endoscopic Diagnosis.—The value of endoscopy for diagnosis in the first line rests on the actual demonstration of the exact seat and character of numerous pathological conditions of the urethra which can not be detected during life by any other means, and which, in fact, were almost or entirely unknown before the introduction of the endoscope. On the other side, the examination enables us to definitely exclude the presence of some or any diseased condition at all, which may be of great importance in guiding investigation into the more remote portions of the genito-urinary tract. It may therefore safely be asserted that the endoscope is essential and indispensable in arriving at a certain diagnosis in chronic diseases of the urethra, and often alone affords the means of adopting a rational and successful plan of treatment.

While naturally demanding a certain technical skill and some practice, like every instrumental examination in the human body, endoscopy does not offer any difficulties which can not be conquered by industrious and energetic efforts. Therefore the diagnosis of chronic diseases of the urethra ought not to be considered complete without an endoscopic examination, certainly not by those who claim to make these diseases a special study.

The diagnostic facilities which it offers by no means exhaust the practical value of the endoscope. On the contrary, by making diseased portions of the urethra accessible not only to the eye but also at the same time to the hand of the surgeon, it affords a means for effective and

direct local treatment, often in cases where other means have utterly failed. The very nature of some lesions described above immediately invites the application of drugs or operative interference which have proved effective in the treatment of affections of the mucous membrane of other organs.

That the scope of endoscopic treatment is a limited one is readily conceded; equally so that in many cases it will be useful only in connection with other treatment. Still, there remain occasions enough where it alone effects a final cure. In general, endoscopic treatment will be restricted to superficial alterations of the epithelium, subepithelial tissue, the mucous membrane proper, and to the glandular apparatus; while more deeply seated processes, new formation of connective tissue, and sclerosis, will remain unaffected. Strictures, therefore, and all cases with decided loss of elasticity, offer no field for endoscopic treatment unless associated with superficial lesions, except occasionally for the possibility to make a narrow stricture accessible to explorative bougies.

Endoscopic Treatment.—The treatment itself consists in the first line in the application of drugs in solution or in powder by means of cotton tampons or of a spray, or directly of the substance itself. Nitrate of silver is the most useful of these drugs, and is applied in solution of from one to twenty per cent, in which strength it does not develop really caustic or destructive effect, but only, according to the strength, increases the natural process of exfoliation and proliferation of the epithelium; while a fifty-per-cent solution, like the crystallized salt itself, really produces a more or less deep eschar.

Next to the silver nitrate the preparations of iodine are most valuable. Lugol's solution (iodine 1, iodide of potash 2, water 12) alone, or with equal parts of pure carbolic acid, bichloride of mercury in one half or one per cent alcoholic solution, sulphate of copper in three, five, ten, or twenty-five per cent solution and in crystals, liquor aquæ plumbi subacetatis, tannin as the glycerol of tannin, or ten-per-cent alcoholic solution, ten and fifty per cent solutions of chromic acid, liquor ferri perchloridi, powders of iodoform and of dermatol, resorcin, ten and twenty-five per cent solutions in glycerin, and trichloroacetic acid in ten and twenty per cent solutions, complete the list of drugs. Ichthyol and salicylic acid probably deserve to be tried.

The immediate effect of all these medicines can be watched by the eye. In most instances the surface of the mucous membrane becomes dry, thereby bringing out more prominently every irregularity of the surface. Nitrate of silver leaves more or less white patches, the same as trichloroacetic acid. Bichloride solutions likewise produce a dry, pale surface, while glycerin does not change the appearance of the mucous membrane, and apparently renders the applications less painful.

The sensations produced by these applications vary greatly according to the individual susceptibility, but as a rule the posterior portion, including the prostatic and membranous, are much less sensitive to the chemical irritation. The more the meatus is approached, the stronger the expressions of pain. Even the application of mild substances produces, as a rule, a more or less acute inflammation, which generally becomes manifest by an increase of secretion within the first twenty-four or thirty-six hours, or sometimes after that period, and then gradually and spontaneously disappears again. If it does not show any diminution two days after its appearance, one or two injections of a mild solution of sulphate of zinc or some similar salt are usually sufficient to reduce it to its former insignificant state. After the application of stronger solutions of copper, of corrosive sublimate, and tincture of iodine, the secretion generally becomes more copious and more watery; after nitrate of silver and carbolized iodine, more purulent. During the period of exacerbation the urethra is generally somewhat sensitive, particularly during micturition. It is therefore absolutely necessary to advise the patient beforehand of the probability of the occurrence of pain and increased discharge.

If even slight hæmorrhage occur during examination, it is equally advisable to inform the patient that he may find a little blood in his clothes, or rather on the pad of cotton which is usually placed in front of the meatus, for nothing is more liable to frighten patients than the unexpected appearance of blood. As a rule, the patient is to be enjoined to delay urinating as long as possible. Beyond the sequelæ just described, and occasionally a more continued renewal of copious discharge, where a sufficiently chronic condition had not yet been attained, I can not say that I have met with any particular accidents which would justify me to consider endoscopic treatment more dangerous than other methods of treatment. Epididymitis, particularly, occurs but rarely, certainly less often than during the use of sounds.

The length of the interval between the single endoscopic sittings has to depend partly on the sensitiveness of the patient, the intensity of the reaction, and on the strength of the application. Even mild treatment ought not to be repeated oftener than every three or four days, but with the stronger solutions not less than five to seven days ought to be allowed to pass, and as soon as improvement becomes more manifest, the intervals ought to be increased to ten days or two weeks.

It is impossible to definitely state in which conditions the one or the other drug, the milder or the stronger solutions, are to be preferred. At the first application it is safest to apply a solution of nitrate of silver not stronger than two and a half per cent, with or without iodoform or dermatol, which is not liable to irritate much. The conditions of the mucous membrane, together with the character of the secretion, will determine to

a certain extent the selection of milder or stronger remedies. In more diffuse hyperæmia and swelling, with mucous discharge, the milder solutions of nitrate of silver and sulphate of copper and trichloroacetic acid will be serviceable; in more pronounced shrinking of the tissue, iodine or stronger copper solution. Granulations demand tincture of iodine, ten to twenty per cent solutions of nitrate of silver, and sulphate of copper, and particularly in connection with widened lacunæ, carbolized iodine and sulphate of copper in crystals. As long as gonococci are present, Burckhardt strongly recommends the use of one-per-cent alcoholic solution of corrosive sublimate, the good effects of which I am able to confirm. The brown, dry patches of the lateral folds are best influenced by iodine, under which they gradually assume a lighter hue and smoother surface. The cauteries are applied only to small excrescences which can not well be reached with instruments.

Erosions are the least treatable conditions. I have seen the best effects from a very mild solution of silver, even less than one per cent, and of iodoform. The white patches of thickened epithelium become less prominent under applications of tincture of iodine, and particularly of chromic acid, but it seems doubtful whether they really demand any treatment, as it is not apparent that they cause trouble.

The changes in the prostatic urethra, particularly the swelling of the colliculus, require as a rule the strongest applications. With Burckhardt, I have sometimes found the only effective remedy to be the galvano-cautery. Polypi and large warts require removal by surgical means. Only for smaller excrescences cauteries are sufficient. Gruenfeld has constructed quite a number of instruments for this purpose. The instrument which I devised in 1887 has been found useful by several surgeons. It consists



FIG. 7.

of two concentric metallic tubes, the inner one revolving readily within the outer. At the same point near the visceral end of the tubes there is in each an elliptic window. The instrument is introduced so that the polyp projects into the lumen between the two openings. Revolution of the interior tube (the edges of whose windows are sharpened) then cuts off the tumor at its base. The sharp curette can also be used for the removal of smaller growths. The most convenient way, however, for the removal of all growths is probably by the different shapes of the galvano-cautery devised by Burckhardt.

It is remarkable how much changed the urethra often will appear after the first application of some mild solution. The mucous membrane gradually assumes a more natural pale color, the surface becomes smoother, the lacunæ Morgagni show sharp, well-defined edges and become more and more shallow, differing less in color from the surroundings. The improvement of these organs seems to have a decided relation to the number of filaments in the urine.

With the increasing strength of the epithelial covering the tendency to bleeding gradually subsides. Hæmorrhagic tendency is best treated by applications of resorcin, iodine, or perchloride of iron diluted with glycerin. Altogether, however, the results of endoscopic treatment are quite variable. Sometimes you will be surprised by the rapidity with which the mucous membrane assumes the normal aspect and the symptoms cease; and on other occasions the patience of everybody concerned will be tried to the utmost. It is therefore advisable to abstain from any assurance with regard to the probable duration of the treatment. Whenever, after a reasonable time and after judicious changes in the selection of remedies, apparently no progress is made, it becomes necessary to abandon endoscopic applications, at least for a time, and resort to some other mode of treatment, occasionally even to some internal remedy. Often enough a cure may then be effected by a method which had been tried in vain before, but which will prove beneficial now under conditions altered by the endoscopic treatment. The concomitant use of a mild injection, at least at the beginning of the treatment, is generally advisable. By gradually omitting the same while the patient is allowed to resume his former habits of life, the danger of relapse is greatly diminished.

The effects of endoscopic treatment are but rarely very brilliant and magic-like. As a rule, a cure will be obtained only after a number of applications and after patient work; but, considering the meager success of other means, and the deplorable condition of many patients, a method which certainly effects a cure in a limited number of cases in which other means have failed, deserves a permanent place in the therapeutics of chronic urethral diseases, which after a long trial it has now fairly won.

GONORRHEAL OPHTHALMIA.

Syn.: Gonorrhæal Conjunctivitis.

By JOSEPH A. ANDREWS, M. D.

GONORRHEAL ophthalmia is an acute purulent inflammation of the conjunctiva, caused by the transfer of the discharge from an acute or chronic gonorrhæal inflammation of the genitals either by the patient himself conveying the poison from his genital organs on his fingers, or linen, towel, etc., either consciously or during sleep, or from the transfer of the poison from an eye similarly affected.

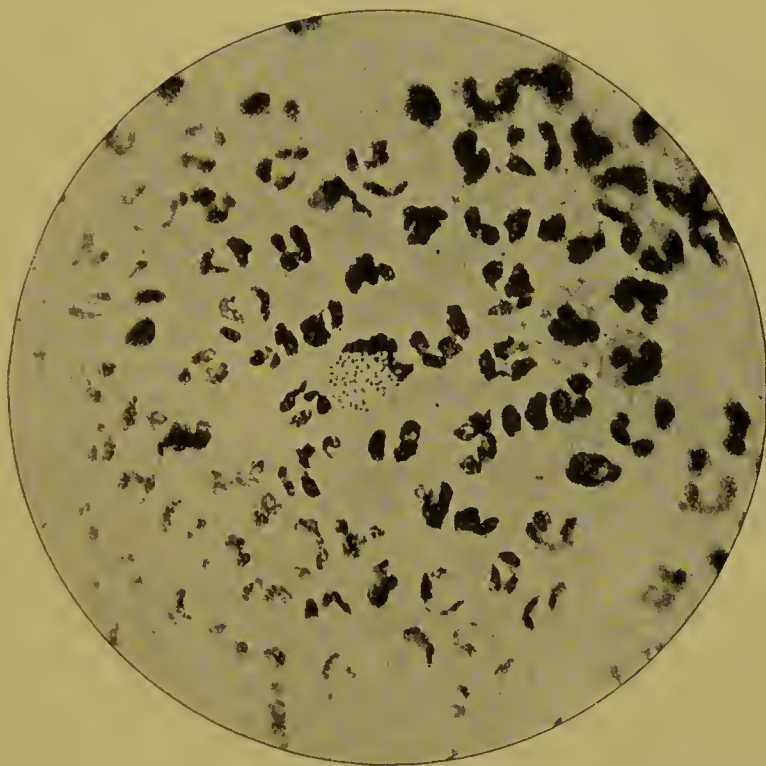


FIG. 1.—Gonococci in conjunctival discharge. Stained according to the method of Schütze. The pus-cells and their nuclei are brought out by the double-stain with safronin. Only one pus-cell shows the gonococci in this field, but the picture is more satisfactory than the others in which several pus-cells contained them. Zeiss apochromatic objective 2.0 mm., numerical aperture 1.2° and projective eyepiece No. 2. The amplification, about 500 diameters, revealed a very satisfactory microphotograph of this diplococcus, but the reproduction process gave a too faint impression; the picture was, therefore, enlarged about one half in the reproduction. Greater amplification than 500 diameters loses in sharpness what it gains in extent. Dr. E. K. Dunham, Director of the Carnegie Laboratory, this city, kindly made the microphotograph from which this illustration has been produced.

The investigations of Bumm, and quite recently those of Wertheim (Centralblatt für Gynäkologie, 1891, No. 24, p. 484), who cultivated the gonococcus on human blood-serum, show that a specific germ, the gonococcus, first described by Neisser, of Breslau, in 1879, is the active agent of this disease. The gonococcus almost always occurs in the form of diplococci. In stained preparations and with the highest power—i. e., homogeneous oil-immersion and Abbé's condenser—this coccus is seen as an elongated body, with a furrow in its middle, dividing it into two halves. This is the appearance of the coccus undergoing division.

The gonococci in the secretion lie chiefly in the protoplasm of the cells in small, irregular heaps. It may readily be stained by Schütze's method * (München med. Wochenschrift, 1889, No. 14).

In the following table I have endeavored to show the relative frequency with which the gonococcus is found in active and chronic gonorrhœa:

	Number of cases examined.	Number of cases in which gonococcus was found.
Acute urethral gonorrhœa (secretion examined before treatment was begun).....	17	17
Chronic urethral discharge following gonorrhœa (all these patients had been treated, but were not under treatment when the secretion was examined).....	144	108
Purulent ophthalmia in adults (typical clinical picture of gonorrhœal conjunctivitis; all of these patients, excepting two, had also active urethral gonorrhœa).....	72	72
† Purulent ophthalmia in new-born (with typical clinical picture of gonorrhœal conjunctivitis).....	122	122
Purulent ophthalmia in infants, between two and three months old.....	9	3
Total.....	364	322

Purulent ophthalmia does undoubtedly occur quite independently of gonorrhœa; but in such cases the clinical picture of gonorrhœal ophthal-

* The carefully prepared cover-glass preparation is placed from five to ten minutes in a cold filtered saturated solution of methylene blue, prepared with a five-per-cent watery solution of carbolic acid. Next wash cover-glass in water and place it for a moment (long enough to count one, two, three, slowly) in a solution of acetic acid (5 gtt. acetic acid to 20 c. c. distilled water), and at once again thoroughly wash cover-glass in pure water. The gonococci remain distinctly blue.

† Since the publication of the above table (New York Med. Jour., June 21, 1890, p. 632) the writer has examined the secretion from the vagina of the mothers of eighty-eight infants, in which ophthalmia developed from fifty to seventy-two hours after birth. The gonococcus was found in two only of these cases in the mother and child—the one infant being infected at birth and the other six days after birth through carelessness on the part of the mother. The typical clinical picture of gonorrhœal conjunctivitis was absent in eighty-six cases; nevertheless, one eye was lost in five infants and both eyes in one infant, the disease being non-gonorrhœal.

mia is absent, and the disease has not, in my experience, been of the severe type which is nearly always seen in gonorrhœal ophthalmia. Gonorrhœal pus contains, in addition to the specific diplococci, other bacteria, some of which look very similar to the gonococcus; and when such diplococci, morphologically identical with the gonococci, are found outside of pus-cells or in suspected fluid which does not contain pus, it is impossible to fix their character until we have resorted to a staining method by which we now believe we are able to differentiate them from all others which they resemble morphologically. The Gram-Roux* method is the best known at present for this purpose.

Period of Incubation.—It is generally impossible to fix the exact moment at which the poison of gonorrhœa has been brought in contact with the eye. Bumm, in his successful inoculation of the urethra with a pure culture of the gonococcus, stated that, for two days following the inoculation, no phenomena were observed. On the third day there was burning in passing urine. However, objective signs of infection may have preceded this subjective symptom for a short time. Moreover, gonorrhœal pus is more virulent than the pure culture of the gonococcus. This fact would seem to be established by the observation that investigators have not always succeeded in reproducing the disease with cultures of the gonococcus; whereas gonorrhœal pus, placed on a healthy human

* Gram-Roux method: A drop of the suspected fluid pus, etc., is placed in the middle of a clean cover-glass; a second cover-glass is laid upon this, and the two are pressed gently together; the cover-glasses are separated by *sliding* one over the other, not pulling them apart. The cover-glass is now passed two or three times slowly through the flame of a spirit-lamp to coagulate the albumin. The staining is now done by immersing the specimens for twenty minutes in an aniline, gentian, or methyl-violet solution, which should always be freshly prepared: add a few drops of pure aniline-oil placed in a test-tube three quarters filled with distilled water and thoroughly shaken. The emulsion is now filtered, and to the clear aniline water is added drop by drop a concentrated solution of methyl-violet (methyl-violet 2.25 parts, distilled water 100 parts) until a slight cloud appears. Excess of color is removed from the cover-glass by washing in a stream of water. The specimen is next immersed for five minutes in the iodine-iodide-of-potassium solution (iodine, 1 part; iodide of potassium, 2 parts; distilled water, 300 parts). After this, the washing is done as before. This procedure fixes the color on the micro-organisms in general. The specimen is now examined while still wet with an oil-immersion lens. If micro-organisms resembling the gonococcus are found, we proceed to test by decolorizing with alcohol. Gram's liquid does not fix the color on the gonococci; alcohol removes the color from them. The specimen is treated with absolute alcohol until the color is as completely removed as possible. It will be now found that all gonococci have disappeared, while all the other organisms which may have been present will be distinctly visible. If, after having been decolorized in alcohol, the specimen be again lightly stained with a solution of Bismarck brown (care must be taken not to overstain; a few drops of the Bismarck-brown solution are allowed to remain on the preparation for six to ten seconds), the diplococci which disappeared under the action of alcohol will again be seen, but of a lighter color than other diplococci (not gonococci) which may have been present in the specimen, and which still retain the original stain.

conjunctiva, reproduces the disease with the precision of a physical experiment. We may expect to find signs of infection within forty-eight hours after contact of the poison. These signs at the outset will be those of simple catarrhal conjunctivitis—i. e., hyperæmia of the conjunctiva and lachrymation.*

Symptoms.—The first signs of infection are hyperæmia of the conjunctiva, increased lachrymation, and a sensation of irritation, as if a foreign body—i. e., dust—were lodged beneath the lids. This condition is rapidly intensified, and the pronounced picture of the disease is reached on the second or third day. At this time the eyelids are intensely red and glistening, painful to the touch, and so much swollen and œdematous that the patient is generally unable to open the eye. On separating the lids, a copious watery discharge,† with flakes of mucus, pus, and epithelium suspended in it, escape. The conjunctiva is of a deep red; its surface is smooth and glistening, or, in the worst cases, there is a plastic infiltration into the conjunctiva, especially noticeable in the swollen conjunctiva of the globe. The retrotarsal fold of the conjunctiva may also be much swollen and come into view when the lids are separated. When the conjunctiva of the globe is much swollen (chemosis), it forms an annular wall around the cornea (see colored plate, Fig. 2, right eye). The *local temperature* is increased, and the pain in the eye and frontal region is very severe.

The bodily temperature even in the severe cases does not usually run high, but the loss of sleep and the consciousness of the danger to the sight are so demoralizing in many instances as to make the patient feel like a very sick person. The disease progresses very rapidly, and the discharge, undiminished, becomes more turbid, and finally pure pus. The pus wells out from between the lids, and flows over the cheeks, where it dries in scabs, excoriating the skin beneath. If now the lids be separated, the pus will be seen covering the surface of the cornea, and collected in the hollow formed by the swollen conjunctiva surrounding it, presenting an appearance which might excite the suspicion that the cornea is

* These are the signs for which we must especially be on the lookout in the fellow-eye, which, if unaffected, will be covered with the protective shield. But we must not confound the slight injection of the conjunctiva in such cases (which may be due to the heat, etc., occasioned by the protective shield) with true infection. A quiet gonorrhœal conjunctivitis (hyperæmia, increased lachrymation, and photophobia) which has been observed in gonorrhœal rheumatism, may puzzle us in a given case of active, urethral gonorrhœa with rheumatism, but such severe purulent conjunctivitis does not develop in these rare cases, and the treatment must always be of the mildest kind.

† The attendant should be careful of his own eyes in separating the lids in this stage, as fluid in considerable quantity is sometimes pent up in consequence of the edges of the lids being glued together, and when the lids are separated the fluid may be projected for some distance.

involved in a suppurative process. This suspicion is removed or confirmed by washing away the discharge. The ocular conjunctiva, if swollen, is soft, or in the severe cases firm, in consequence of the serous effusion into the conjunctival and subconjunctival tissue being replaced by a plastic effusion. The great danger now is the implication of the cornea. The swelling and pressure of the eyelids, the chemosis, compress the vessels supplying the cornea and thus impair its nutrition, the evidence of which will be a hazy appearance of the cornea. But it is the irritating noxious character of the discharge which produces *ulceration* of the cornea. Although cloudiness of the cornea is an unfavorable symptom, it frequently disappears under faithful attention to the antiphlogistic treatment—cold and irrigation. Ulceration of the cornea is always a very serious complication; the earlier in the history of the disease it occurs, the graver the consequences. The ulceration (see colored plate, Fig. 2, right eye) shows itself as a small loss of surface of the cornea at its center or periphery. The ulceration spreads in surface and depth, until, unless arrested by treatment, it involves a more or less considerable extent of the cornea, leading to perforation and its consequences, prolapse of iris, staphyloma of the cornea, and, in the worst cases, to purulent panophthalmitis.

But these terrible consequences are not inevitable, even where the cornea is involved to a considerable extent in ulceration, for we are often able, by appropriate treatment and constant vigilance, to rescue the eye, and give the patient useful vision by the performance of an iridectomy after all signs of irritation have disappeared. But this is the darkest side of this terrible disease. In a large proportion of the cases we may succeed in directing the disease through a favorable course. Then there will follow a gradual diminution of the swelling and secretion, and recovery in about six weeks. In other cases in which the cornea escapes injury, the conjunctiva takes on a condition of chronic inflammation, which does not usually endanger the cornea, and yields to treatment.

Anatomy.—We are indebted to Bumm for the anatomical changes in gonorrhœal conjunctivitis. Bumm's investigations were almost exclusively of preparations of gonorrhœal conjunctivitis in the new-born. These inquiries showed that the gonococcus penetrated the cylindrical epithelium and extended principally in the intercellular tissue, leaving the parts covered with pavement epithelium intact. Tonlon, Dinkler, Jadassohn, and others have disproved this latter statement, by showing that the gonococci penetrate into the upper layers of the subepithelial tissues and lie there mostly free. The invasion by this bacterium gives rise, on the one hand, to exfoliation of the epithelial layer; on the other hand, in the conjunctival tissue, to the migration of white blood-cells, infiltration with round cells, and suppuration. The chief multiplication of the gonococci takes place in the secretion and in the epithelium. Bumm surmises that the

gonoeoci in the subepithelial tissue die rapidly, because the conditions there are not favorable to their further development.

Influence of Age.—Recently, Spicer (The Royal London Ophthalmic Hospital Reports, December, 1891, pp. 211–247) has shown statistically, in his eminently practical paper, that there is a marked difference in the resistance of the tissues to the destroying action of the poison of gonorrhœa in the different periods of life. The cornea suffers least in early adult life. In every case in which the age was over thirty-eight years, the eye was lost. However, in this connection we should take into account the character of the inflammation. The severer forms of the disease, in our experience, are as destructive in early adult life as later.

Prognosis.—The issue in every case will depend on the duration of the disease before the application of treatment, the character of the inflammation,

the severity of the inflammation, and, further, upon the condition of the eye previous to infection. An eye which is the subject of a pre-existent chronic inflammation of the conjunctiva—i. e., trachoma with pannus*—will be less seriously affected by the infection with gonorrhœa than when the conjunctiva is normal.

Treatment.—The patient must be put to bed. Two nurses, one for the day and one for the night, are indispensable. If one eye only is affected, the healthy eye must be protected. The best protective covering is Buller's



FIG. 4.—Buller's protective shield (reduced one half in size).

shield (Fig. 4). This shield consists of two pieces of rubber adhesive plaster, one four inches the other four and a half inches square, between which, in a hole in the center, an old-fashioned deep watch-glass is fastened. The adhesive plaster is fixed by its free edge to the nose, forehead, and cheek, leaving only the lower and outer angle a little open for purposes of ventilation. This shield enables the patient to see, and the surgeon to inspect the eye, without removing the dressing.

The eye must be kept as free from discharge (day and night) as possible by frequent washing, the frequency of the washing to be regulated by the amount of the discharge; in other words, the discharge must be washed

* Previous to the introduction of jequirity, trachoma with pannus was in aggravated cases treated by inoculating the eye with gonorrhœal pus.

away as soon as it forms. In the interval of washing, iced cloths must be kept applied (day and night) to the eyelids. The cold is best applied by means of pledgets of linen, two inches square, kept cold on a block of ice at the bedside, and laid on the affected eye, changing the linen before it becomes warm. These pieces of linen must never be reapplied to the block of ice, but be *burned at once*. The eye should be washed with a solution of boric acid (three per cent), or bichloride of mercury (1 to 10,000 or 1 to 20,000); the boric-acid solution is preferable. The solution of

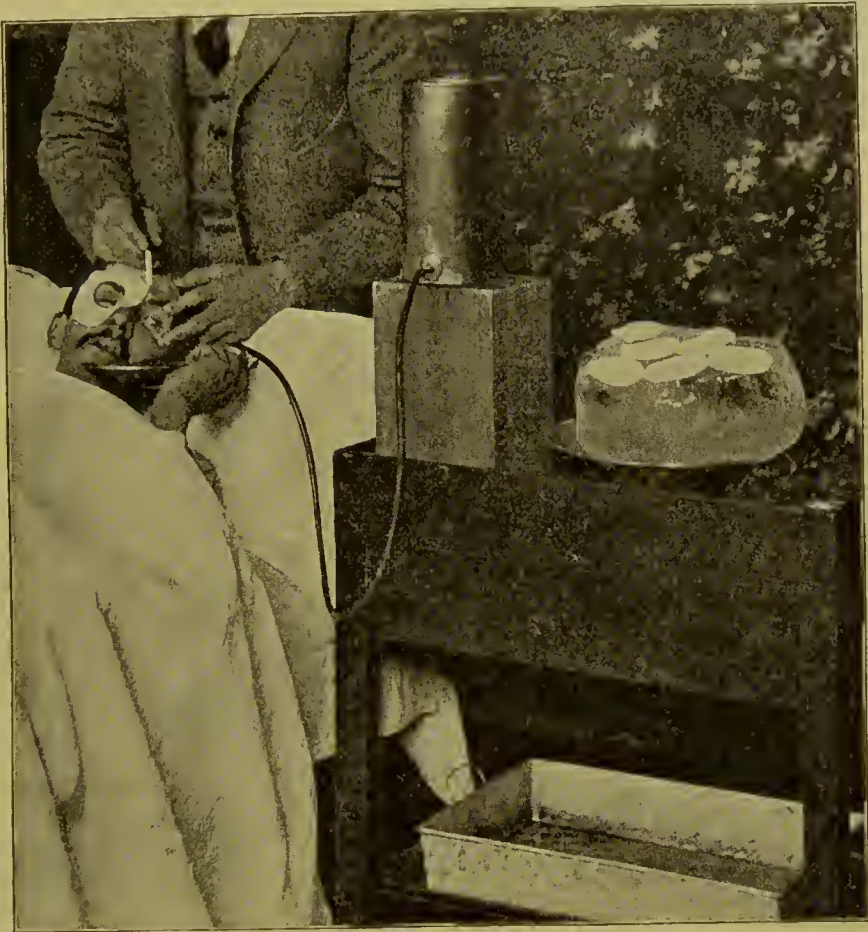


FIG. 5.—Patient in position for irrigation. Pus-basin held by patient under affected eye. Buller's protective shield over right eye. Pieces of linen on block of ice. Pan under table to receive soiled iced-cloths.

boric acid should be prepared with boiled water from the kettle, to insure its being clean. The solution of bichloride of mercury should be prepared with distilled water. The solution should be used cold.

Fig. 5 represents the method employed at the Charity Hospital for applying cold and irrigating the eye. The right eye has been protected by Buller's shield; the head is inclined toward the left, and a pus-basin held by the patient himself just beneath the eye receives the discharge when the eye is irrigated. The fountain syringe, with rubber tubing attached,

is placed just high enough above the head of the bed to give the flow sufficient force to play in a gentle stream on as much of the conjunctiva as can be exposed by gently separating the lids.

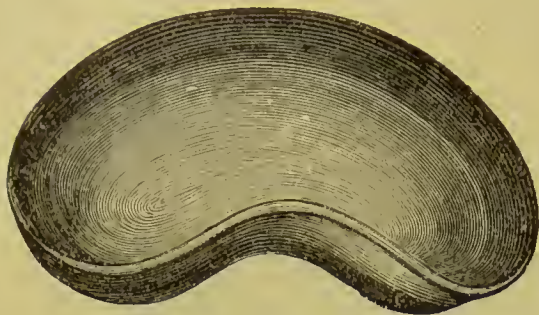


FIG. 6.—Pus-basin.

the solution is flowing through it, it should be held slightly away from the eyeball. Only a carefully trained nurse should be intrusted with this instrument. A glass tube a quarter of an inch in diameter and two inches long is a useful substitute for this irrigator. The lids being separated with the thumb and index-finger and the upper lid slightly tilted away from the eyeball, the point of this glass tube is held close to the eye (without touching it), and the stream directed up into the conjunctival *cul-de-sac*, and the discharge in this part washed out as thoroughly as possible. It is our custom at the Charity Hospital, in washing out the eye, to allow the stream to play on the conjunctival surfaces for one, two, or three minutes at a time when the discharge is profuse. If the swelling of the lids is very conspicuous, and it as well as the chemosis shows no disposition to subside under treatment, the outer commissure may be cut to the bottom of the conjunctival *cul-de-sac*. This is best done with a pair of strong, sharp scissors that will cut to the points. The lids being separated † with the index-finger and thumb (as shown in Fig. 8), thus putting the skin slightly on the stretch, and enabling the surgeon to make a straight cut, one blade of the scissors is inserted between the eyeball and the lid, and the point well down to the bottom of the

Some years ago I devised an irrigator* which I have found useful in many cases. It must be inserted with great care and gentleness beneath the upper lid, to avoid injury to the cornea and giving pain to the patient, for the lids are generally extremely sensitive. When beneath the lid, and

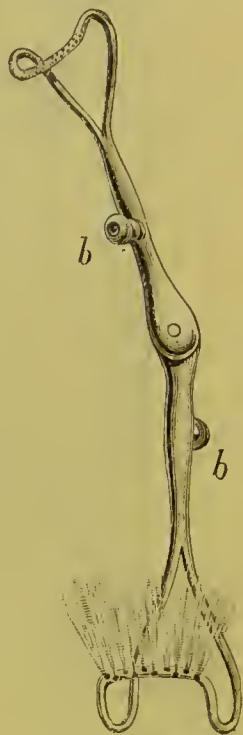


FIG. 7.—Author's irrigator. Consists of a hollow folding lid-elevator of large and small size. Tubing of fountain-syringe is attached at *b*.

* New York Med. Jour., 1885. This irrigator is simply a modification of the folding-lid elevator, one extremity smaller than the other, the whole being hollow, with fine holes at the extremities for the passage of the fluid.

† The fingers should not touch the eyeball, but be applied to the upper and lower borders of the orbit, respectively, and the lids separated by rolling the skin over the bone.

cul-de-sac. The blades are now quickly and firmly brought together, making the cut through the skin and conjunctiva, along the line of incision shown at A in Fig. 8.

Indications for the Application of Nitrate of Silver.*—In my hands, nitrate of silver has been more useful than any other remedial agent in the treatment of gonorrhœal conjunctivitis. But nitrate of silver is never depended upon to the exclusion of the most exacting cleanliness and attention to the uninterrupted application of cold. The silver assists, nothing more; and unless we employ it at any other time than when it is indicated by the condition of the conjunctiva, it will do harm, even in the weakest solutions.

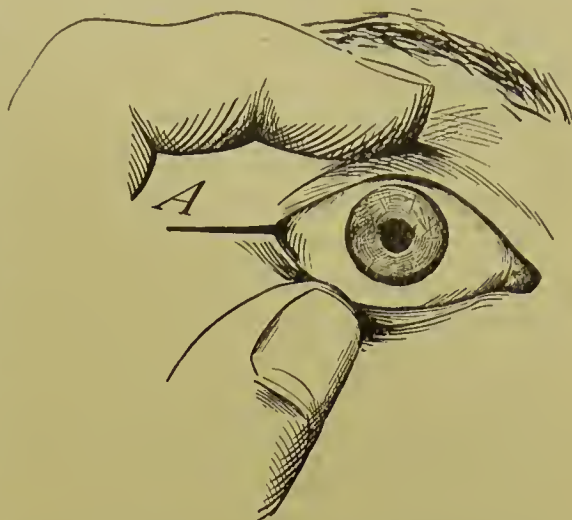


FIG. 8.—Canthotomy. A, Line of incision with scissors.

* Nitrate of silver has been selected, because we consider it the safest germicide to employ in gonorrhœal conjunctivitis. But its value as a germicide is limited. When we have thoroughly tested the germicidal value of a given agent in the laboratory, as shown by its behavior in pure cultures of the pathogenic bacteria, it does not follow that we are therefore prepared to go forth fully armed for the therapeutical contest. Such experiments have impressed upon us the great importance of cleanliness in the treatment of wounds. They teach us that everything that touches a healthy wound must be free from living pathogenic or pyogenic bacteria. But we are not so clearly informed concerning the safest means to adopt to destroy these bacteria when they are already present in the tissues. There is in the body some power of adjustment of forces by which disease is limited or disposed of; and as we now associate pathogenic bacteria with the cause of disease, and as gonorrhœa, like some other diseases caused by bacteria, is known to be self-limited, and will be eliminated spontaneously, we must assume that the tissues contain a bacteria-destroying agency. The ideal germicide, therefore, would be such a one as would, while destroying pathogenic bacteria, at the same time, instead of irritating the tissues, aid them in their inherent quality of resisting the incursions of the mischievous bacteria. We do not yet possess such a germicide. It is evidently not nitrate of silver. The gonococcus, as has been said, invades chiefly the pus-cells and epithelium. The two-per-cent solution of nitrate of silver exfoliates the epithelium, and destroys the infective properties of the pus in less time and with less harm to the tissues than the stronger solutions, or any other known agent. It is these facts which led the writer to recommend (New York Med. Jour., 1886) the frequent instillation of a two-per-cent solution of nitrate of silver. Sixty years ago Mackenzie (his Text-Book) treated purulent ophthalmia by washing the eyes with a solution of bichloride of mercury (1 part in 4,000) three or four times daily, and brushed a solution of nitrate of silver (4 grains to the ounce of water) over the conjunctiva every six or eight hours. Therefore, in one respect the treatment of purulent ophthalmia with repeated instillations of a two-per-cent solution of silver is not a novelty. But Mackenzie had, of course, no thought of using silver for its germicidal properties; and indeed this solution was laid aside for stronger ones, until the mitigated or solid stick of

Most text-books * on ophthalmology oppose the application of nitrate of silver or any caustic in the active stage of gonorrhœal conjunctivitis. It has been my experience that the instillation of two or three drops of a two-per-cent solution of nitrate of silver in the early stage of the disease has enabled me, during several years, to save many eyes. The course of the disease has certainly, in many instances, been rendered less severe. The solution which I use is never stronger than two per cent. In the early stage of the disease this solution should be applied once only in twenty-four hours, and then by the surgeon himself.

In connection with the application of silver to the conjunctiva, the following facts should be borne in mind: The eschar produced by the silver is thrown off much more quickly, and with less irritation, from the conjunctiva of the lid than from that of the eyeball. The more hyperæmic and succulent the conjunctival membrane, the more rapidly will the eschar produced by the silver be cast off, and the less time will be occupied in the regeneration of the epithelium. In other words, the shorter will be the two periods following the cauterization; i. e., the period of irritation—the casting off of the eschar—and the period of regeneration of the epithelium. If we bear these simple facts in mind, they will furnish us with the indications for withholding or repeating the applications of the nitrate of silver.

The plan of treatment employed at the Charity Hospital is to instill † two or three drops of a two-per-cent solution of silver immediately after the eye has been freed of discharge by washing, the ice-cloths being applied at once after this application. The cold applications here shorten the period of reaction. If the discharge be not profuse, we do not repeat the instillation on that day; should, however, the discharge increase, the swelling of the conjunctiva persist, and the conjunctiva bear the caustic well, then we repeat the application of silver, say, two or three times in twenty-four hours. Our object here is to control the purulent secretion; but we must also always consider the cornea, and the behavior of the conjunctiva toward the caustic. *The application of silver must not be repeated as long as the eschar is present.*

Occasionally cases are observed in which, at the end of the first week,

silver had supplanted them. Some of our text-books on diseases of the eye *still* advise the use of the solid stick of nitrate of silver in purulent ophthalmia, but this recommendation is one of those things which have gained credence from having been transmitted from book to book. *The solid stick of nitrate of silver should never be used in the treatment of purulent ophthalmia.*

* Schmidt-Rimpler advises the use of a weak solution of silver in the active stage of the disease; but he, in common with other authors of text-books, omits to give the indications and contra-indications for the use of silver.

† Or the silver solution is applied to the conjunctiva on absorbent cotton wrapped about the end of a match.

the disease has assumed such a mild type that we are tempted to believe that all the danger is over. We must not be deceived by these appearances, but continue our vigilance just as before. Perforation of the cornea and loss of the eye may occur when the disease seems far advanced toward recovery. We must therefore be on the lookout for acute exacerbations, and remember that in any such case the cornea is exposed to new danger.

Should the cornea become involved, sulphate of atropine (gr. ij- $\overline{3}$ j) is instilled three times a day; or sulphate of eserine (gr. $\frac{1}{8}$ - $\overline{3}$ j) may be substituted in ulceration of the cornea. When the cornea is involved the silver is never instilled into the eye. If deemed advisable to use it at all in such complications, it should be brushed over the conjunctiva of the everted lid.

The two-per-cent solution of silver is preferred, because the weaker solutions have generally been inefficient, and the stronger ones no more efficient, but attended with greater risk. Should the disease be complicated with a diphtheritic process, the nitrate of silver should not be used; and when the conjunctiva is covered with a membranous deposit, we had better withhold its use. The silver in such cases will not penetrate the deposit, but there is danger that the solution may flow into the crater formed by the swollen conjunctiva around the cornea, and, lying there, injure the cornea by removing its epithelial layer, thereby exposing it to infection.

I have abandoned the practice which I recommended four years ago (New York Medical Journal, October 31, 1885), of flooding the surface of the eyeball with vaseline in all cases of this disease. We found that nurses trusted too much to the ointment, and neglected the washing of the eye. We have found the vaseline-oil (poured between the lids frequently and freely) of benefit in those cases of the disease in which the conjunctiva of the eyeball is firm (plastic infiltration); also in all cases after the more acute inflammatory symptoms have subsided, and the conjunctiva ceased to secrete profusely. The duration of gonorrhœal conjunctivitis is from four to six weeks.

Preparations of zinc, carbolic acid, bichloride of mercury, iodoform, peroxide of hydrogen, have absolutely no serious claim upon our consideration in connection with the treatment of this disease, by which statement we mean that "they have been weighed in the balance and (by comparison) found wanting."

The nitrate of silver, in our hands, has proved itself to be the safest and best remedial agent in the treatment of gonorrhœal conjunctivitis; but it is one which requires caution in its application, and full appreciation of the fact that the chief reliance must be placed in the uninterrupted application of cold, and thorough washing of the eye with an un-

irritating aseptic fluid, a saturated solution of boric acid being given the preference.

OPHTHALMIA NEONATORUM.

Syn.: Blennorrhœa Neonatorum.

This disease may result from direct infection from the mother during the birth of the child. When the disease occurs within forty-eight to seventy-two hours after birth, it is most probably in this way. It is, however, more frequently communicated after birth, through the agency of the fingers of the nurse or the mother, or in the first washing after birth, when any infectious discharge which may adhere to the infant's body is mixed with the water of the bath, and in washing the face is introduced between the eyelids. The child may be infected by the mother through her fingers or cloths, which may be soiled with the discharge from her genitals. It is not necessary that the mother's vaginal discharge shall be gonorrhœal; other abnormal vaginal discharges may give rise to purulent conjunctivitis in the new-born and be quite as disastrous to the sight as is gonorrhœal conjunctivitis. In every instance of purulent ophthalmia in the new-born presenting the clinical picture of gonorrhœal conjunctivitis in which I have examined the discharge, I have found the gonococcus. But I am disposed to the belief, based on those microscopic examinations of the vaginal discharge of the mothers and the discharge from their infants' eyes which I have made during the past three years, that ophthalmia neonatorum is, in the majority of instances, not gonorrhœal.

If the blennorrhœa in the new-born is gonorrhœal, it presents, as a rule, the same clinical picture and follows the same course as in the adult—i. e., there are the intense swelling of the lids and profuse purulent discharge. The cornea is also in great danger. As a rule, when originating at birth, it attacks both eyes.

Prophylaxis.—If the mother have a pathological vaginal discharge, thorough and judicious cleansing of her vagina should be practiced before the birth of the child; and when the child of such a mother is born, its eyes should be immediately washed with a saturated solution of boric acid, and two drops of a two-per-cent solution of nitrate of silver (Crede's method) be dropped between the lids of each eye, and ice-cold cloths kept applied to the eyes for about three hours to limit the reaction. The child and mother should not alone be kept from other children, but the mother should be told of the contagious character of the disease, and warned against wiping her child with any towels, sponges, or cloths that may have been used on her own person.

Treatment.—The treatment is essentially the same as that for adults with gonorrhœal conjunctivitis. The discharge must be washed away

(with fountain syringe*) as soon as it forms, and iced cloths applied uninterruptedly to the lids day and night. The surface of the lids (especially the edges) should be smeared with vaseline. The external commissure may be cut to the bottom of the conjunctival *cul-de-sac*, if the swelling and pressure of the lids upon the eyeball seem to indicate such a procedure. The same rules for the application of nitrate of silver apply here as in the case of the adult.

When the clinical picture is that of gonorrhœal conjunctivitis, especially when we do not find the gonococcus in the discharge, we should be extremely careful in the use of nitrate of silver. We should bear this fact in mind, that while the purulent conjunctivitis in the new-born which is not gonorrhœic may still be quite severe and endanger the eye, it often runs a favorable course under the simple antiphlogistic treatment. It is, therefore, in this class of cases, better to wait than to begin the use of silver, until the discharge is decidedly purulent, trusting to the antiphlogistic treatment of cold and irrigation, rather than run the risk of converting, by the use of silver, what might have been a mild process into one of those inflammatory conditions with a great inclination to associate itself with destructive corneal processes, which is frequently known to follow the too hasty and improper use of caustics. We should, therefore, feel our way, and postpone the use of silver until the disease shows a disposition not to yield to antiphlogistic treatment. In this latter event a solution of nitrate of silver, one half to one per cent, may be brushed over the everted upper lid, but not repeated again for twenty-four hours.

In the class of cases in which there is a membranous deposit on the conjunctiva, no silver of any strength should be used. The silver, in such cases, will not penetrate the membranous deposit, therefore it is useless; but if it should come in contact with the cornea, it will exfoliate its epithelium and expose it to infection, which it might have escaped if no caustic had been employed. In this latter class of cases I have seen the best results follow the *flooding of the eye with as much vaseline-oil* as will be retained between the lids. The washing of the eye and application of cold † must, of course, receive the same exacting attention as when the vaseline is not employed.

* The solution should flow in a gentle stream. The ordinary syringe should not be used, as there is danger with it of splashing the discharge into the nurse's eye.

† Where the disease is not gonorrhœic and it is very mild, as shown by the absence of heat and swelling of the lids, it is better not to employ the iced cloths.

EXPLANATIONS OF FIGURES ON PLATE III.

Fig. 2, gonorrhœal ophthalmia in an adult (life-size). Right eye (discharge washed away) shows conjunctiva of globe much swollen (chemosis), forming an annular wall around the cornea, with ulceration of the cornea. Left eye shows swelling and discoloration of the eyelids, with profuse purulent discharge. Fig. 3, gonorrhœal ophthalmia in new born, infant seven days old (life-size), shows characteristic inflammatory swelling and purulent discharge.

FIG. 2.



FIG. 3.



GONORRHOEAL OPHTHALMIA.
FIG. 2 IN AN ADULT.
FIG. 3 IN NEW BORN INFANT.

GONORRHOEAL RHEUMATISM.

By FRANK HARTLEY, M. D.

Definition.—As the result of a blennorrhœal urethritis, commonly and less frequently of a blennorrhœal ophthalmia or vulvitis, certain affections are observed to occur, which, when existing in the joints, bursæ, sheaths of the tendons, the eye, muscles, nerves, and fibrous tissues, are designated as blennorrhœal rheumatism.

Etiology.—In reference to its etiology we believe it to be an infectious process—a wound infection in which the follicular ulcers (so-called gonorrhœal ulcers) in the posterior urethra are for the most part the points of origin of the infection.

Such a position leads us to a belief in an existing gonohæmia or pyohæmia; but in either case we must make our belief subject to the three necessary indications of the proof of any micro-organic origin of the disease.

These conditions are, that one and the same form of micro-organism be always found in a given disease, that it be easily recognized morphologically, by chemical relations and reaction to coloring matters, and that the disease be artificially produced in a healthy individual by inoculation with pure cultures.

Neisser, Bokai, Bockhart, Welanders, and others have carried out these conditions in so far as concerns the urethral inflammation, but in the complications of a gonorrhœa we lack positive proof of the third condition.

Since Bumm demonstrated the truth of the discovery of Neisser the complications of this disorder have been subjected to renewed speculation and study. Very early in the history of the gonococcus as the cause of a specific urethritis, the conclusion was that this micro-organism must be held as the direct cause of its complications.

Brieger, Ehrlich, and Haslund, after a careful study of the subject, denied the presence of the gonococcus in the joint effusions following gonorrhœa of the urethra or vagina.

Petrone, Kammerer, Hall, myself, and others have found a diplococcus in the joint effusions resembling the gonococcus morphologically and in its reaction to coloring matters, but have not produced the neces-

sary proof obtained from cultures, nor demonstrated the presence of the gonococcus in the blood or lymph.

Until cultures and inoculations have been made which will produce the complications of a gonorrhœa in a healthy individual, we must remain content to side with Bumm, Baumgarten, Neisser, Bockhart, Haslund, and Gerhardt, who regard the complications as the result of a mixed infection.

Before the invasion of the gonococcus the healthy urethra contains many micro-organisms, harmless as well as pathogenic. Four varieties of the diplococcus besides the gonococcus have been met with in the urethra of man. Two of these varieties, as the gonococcus, decolorize by Gram's method, but are infrequent in their occurrence. A diplococcus staphylococcus has also been found in blennorrhœal orchitis, subacute prostatitis, and in the normal urethra of children and old adolescents, presenting the same reaction to nutritive media, upon animals, to chemicals, and to Gram's method. It acts identically with the gonococcus, and causes suppuration in the tissues in which it exists. So far as we know, however, no one of these varieties has been subjected to the three crucial tests establishing a proof of their causative action.

These micro-organisms, resembling the gonococcus morphologically, are not able to penetrate the mucous membrane of the urethra until the gonococcus has attacked it and made of it a "*locus resistentiæ minoris*." Gonorrhœa is a purely local affection, which can not develop except upon cylindrical epithelium; and all inflammatory processes which are added to it in other tissues than those covered by cylindrical epithelium are the result of secondary infections.

Such cases as those reported by Dr. Ely (New York Medical Record, 1889) are very instructive in this particular:

The case was one of a man twenty years old, who died in coma, with a temperature 105·8°, pulse 130, and a purulent discharge from the urethra, within a few hours of his admission into the Roosevelt Hospital. The autopsy revealed old pericardial adhesions, fresh vegetations upon the mitral valve, and a hyperæmic liver. The spleen was large and soft. The kidneys contained small infarctions and embolic foci. In the vegetations upon the mitral valve, in the liver, spleen, kidneys, and urethra, staphylococci, streptococci, and bacilli were found. In the urethra a diplococcus resembling the gonococcus was also found.

Nine cases are now recorded, and in some—Besançon's, Lancereaux's, and Ely's—micro-organisms resembling pyogenic bacteria have been found both in the urethra and in the internal organs. These cases seem to establish a series of progressive steps from urethritis to malignant endocarditis and pyæmia. The interpretation of these phenomena taking place at a distance from the primary focus is rendered difficult by the fact that the gonococcus has not yet been found in the blood. Moreover,

cultures and inoculations in the urethra have not been followed by a rheumatism, with the discovery of the gonococcus in the secondary foci, and its cultivation and inoculation into a healthy urethra with the development of a gonorrhœal urethritis. Until such experiments have been fully carried out, we prefer to believe that gonorrhœal rheumatism is a mixed infection, with the urethra as the primary focus in most cases.

The earlier authors, who recognized a connection between a gonorrhœa of the urethra and the rheumatism, spoke of the rheumatism as a true and direct gonorrhœal disease. They considered it in the same category with epididymitis and prostatitis, and ascribed the causation to an injury to the mucous membrane of the urethra in the same manner as when provoked by catheterismus. Such writers were Selle (1781), Hunter (1786), Ricord (1836), Foucart (1846), Brandes (1854), and Fournier (1866). In opposition to these, other authors, among whom may be mentioned Guyon (1836) and Thiry (1856), believed in no genetic connection between urethritis and rheumatism, and insisted that the gonorrhœa simply brought forth a latent diathesis in the individual. Guérin (1864), and Lasèque (1876) maintained that gonorrhœa was nothing more than a general disease *sui generis*, with a long period of incubation.

Lewin (1878) was the principal exponent of the vasomotor theory, and believed that complications considered as rheumatism were reflex in character, as the result of the inflamed urethra. The discovery of the gonococcus led to the theory of a wound infection and to the production of two theories. Of these theories, one, based upon the discovery of the gonococcus in the exudates of secondary foci, considered the rheumatism a true gonorrhœal affection; the other classed the rheumatism as an accidental and secondary affection, brought about by the presence of the pus-coccus in the urethra, and, in order to enter the blood or lymph channels, they considered it necessary that the epithelium be destroyed or altered in its nutrition. This destruction or alteration in the nutrition of the epithelium is brought about by the gonococcus. According to this latter theory, gonorrhœal rheumatism has no specific quality, since it is not impossible for a simple catarrh or a trauma to give rise to the same result. Guyon and Janet (1889), and Fürbringer (1890), have classed the rheumatism as a ptomaine-poisoning, and the direct result of the gonococcus invasion.

Such are the various theories that have been presented; and as none have been thoroughly proved, we prefer, in the light of the present facts, to consider gonorrhœal rheumatism as a mixed infection.

Seele and Swediaur, in 1781, were the first to observe articular affections in gonorrhœal subjects, but it was reserved for Hunter, Cooper, Brodie, Bonnet, Diday, and Fournier to establish the fact that this was

not a mere coincidence, but involved a relation of cause and effect—i. e., certain persons having gonorrhœa acquired a peculiar form of rheumatism which existed with every successive attack of gonorrhœa.

Subsequent investigations have shown that the structures involved were much larger than were at first described, and to-day the lesions may be said to involve the joints, sheaths of tendons, muscles, bursæ about the joints, and fibrous tissues. Occasionally the peri- and endocardium, the nerves, and meninges of the brain and cord, are attacked.

We understand that the acute variety of inflammation of the joints includes four distinct pathological conditions, each one of which has its distinctive name as follows : *Serous synovitis*, *sero-fibrinous synovitis*, *sero-purulent synovitis*, and *purulent synovitis*.

The chronic variety is represented by the word hydrarthrosis, the pathological condition of which is a chronic serous synovitis or a papillary synovitis, and in rarer instances by an ankylosing arthritis or an arthritis deformans. Although the number of autopsies in gonorrhœal rheumatism are not few, yet we are not able to obtain from them the pathological conditions existing in the milder varieties, since it is only in the very severest cases that the result is fatal. In that variety which approaches the serous inflammations, all we have are the records of a few cases where the fluid has been withdrawn from the joint. The exudate was in these cases straw-colored or lightly tinged with blood, and consisted of large epithelioid, white blood-cells, and albumen. In this sero-fibrinous variety the exudate has consisted in large amount of fibrin in addition to epithelioid and white blood-cells. In the sero-purulent variety the fluid has been mucoid in character, light green in color, the sediment of which consisted largely of pus-cells, most of which showed a fatty metamorphosis. In two cases mentioned by Laboulbène, the fluid was of a deep yellowish color, consisting of a sticky alkaline fluid containing no mucine, but pus-cells and fibrin. In the suppurative variety, Fournier, Haslund, and Wyszemirski have found the joint filled with pus, the articular cartilages eroded, and the bones bare, with the periosteum separated from the shaft of the articulating bones for a long distance from the joint.

The outcome of these varieties of acute gonorrhœal rheumatism is either a complete *restitutio in integrum*, which is the case with the serous variety as a rule, and less frequently in the sero-fibrinous and sero-purulent, or a restriction in the motion of the joint, commonly seen in the purulent variety, and less frequently in the sero-fibrinous and sero-purulent varieties. As the result of constantly recurring synovites, hydrops (or chronic serous synovitis), synovitis papillaris, or arthritis deformans, are not uncommon. Statistics on this subject show that in 35 per cent of the cases (106 in 299, Bornemann) a complete resolution takes place. In 65 per cent of

the cases (193 in 299) the motion was restricted or completely lost. In the polyarticular variety, and less frequently in the monarticular variety, where several attacks have occurred, the pathological condition remaining is a papillary synovitis, arthritis deformans, and a chronic serous synovitis. In the chronic serous synovitis the restriction to motion is very slight; such may be the case also with a papillary synovitis. In the arthritis deformans, however, owing to the osteitis rarificans in the earlier stages and the deformities induced by the softness of the bones, the restriction to motion in the joints is more marked. Some of these cases of the chronic gonorrhœal rheumatism which are polyarticular in character have been attended with a marked amyotrophic condition in the muscles in the neighborhood of the joints, and in rare instances in groups of muscles in no way connected with the joint involved.

Situation.—The frequency with which the various joints are involved is, according to Nolen, who has collected 308 cases, as follows: Knee-joint, 86; ankle, 52; shoulder, 29; hand, 26; hip, 15; fingers and toes, 17.

According to Fournier, two thirds of the cases occur in the knee, one fourth in the ankle, and one fifth in the fingers and toes. Four cases have been described in the vertebral joints. According to Finger, who has collected 375 cases from various authors: Knee-joint, 136; tibio-tarsal, 59; wrist-joint, 43; phalangeal, 35; elbow, 25; shoulder, 24; hip, 18; temporo-maxillary, 14; metatarsal, 7; sacro-iliac, 4; sternoclavicular, 4; chondrocostal, 2; intervertebral, 2; peroneo-tibial, 1; cricoarytenoid, 1.

Of 348 cases collected by Jullien, 205 were polyarticular ($58\frac{9}{10}$ per cent), and 143 were monarticular ($41\frac{1}{10}$ per cent). According to others, $19\frac{1}{2}$ per cent of the cases are distinctly monarticular, $12\frac{3}{4}$ per cent are distinctly polyarticular, and in $67\frac{3}{4}$ per cent more than one joint is involved, though the disease is not distinctly polyarticular.

Date and Development.—The time for the occurrence of the rheumatism is rarely before the fifth day. In the majority of cases (75 per cent) it occurs during the first month. In 25 per cent of the cases it occurs during the second and third months in equal proportion. We are to remember that gonorrhœal rheumatism is not generally a complication of the recent but of the older cases.

Duration.—The duration of the joint lesions in 299 cases collected by Bornemann was on the average sixty-eight days, so that it is fair to infer that the duration will be about two months.

Frequency.—The frequency of gonorrhœal rheumatism as a complication is small. Gresolle gives it as $2\frac{8}{10}$ per cent. Besnier and Jullien give it a frequency of two per cent.

It occurs more frequently in men than in women or children, and as

a complication not only of the urethra, but of the vulva, vagina, and conjunctiva. Lucas describes two cases following gonorrhœa of the conjunctiva in the newborn; Deutschmann, following an ophthalmoblenorrhœa; and myself in five cases of vulvo-vaginitis in children.

The joint lesions occur most frequently as a serous, sero-fibrinous, and sero-purulent exudation. In rarer instances a purulent exudation is present. This exudate is well marked, and fluctuation, especially in the knee, is easily appreciated if it be of the serous variety.

Course and Results.—According to the character of the exudate the synovial membrane and superjacent tissues are infiltrated, tense, and reddened. All the local symptoms of an inflammatory nature involving the parasynovial and cutaneous tissues are more marked in the sero-purulent and purulent than in the serous variety. Though the three varieties—serous, sero-fibrinous, and sero-purulent—show a marked tendency to resolution in the milder cases, this is not the case in the severer forms. The sero-purulent, unless mild in character or aborted by treatment, leads to a superficial destruction of the joint surfaces, and ankylosis or perforation.

Such results of the sero-purulent variety have been described by Duplay and Bruns. In the sero-fibrinous variety an ankylosis from the sealing together of the joint surfaces is also to be feared. Ollier and Gosselin consider this variety as not uncommon. Nieaise has reported fourteen such cases. The purulent variety, though rare, leads to perforation of the joint and subsequent ankylosis. The general tendency of all varieties is to become chronic and to remain as a hydrops, an ankylosis, papillary synovitis, or an arthritis deformans. This is especially the case where recurrences are frequent with every new infection.

In general, the attack begins acutely with pain, heat, and a febrile movement of 100° to 102° . This is, however, only present at the beginning of the attack. One joint is sometimes involved. Commonly several joints are affected, and it is the rule for them to be involved one after the other.

The varieties of gonorrhœal joint lesions have been described under the following forms:

1. Blennorrhœal arthralgia.
2. Hydrarthrosis.
3. Polyarticular subacute arthritis.
4. Suppurative arthritis.
5. Plastic monarticular arthritis.
6. Blennorrhœal arthritis deformans.

We prefer, however, to adopt a nomenclature which is more in accordance with the terms used in other diseases, viz.:

Articular gonorrhœal rheumatism. .	{	Monarticular.	{	Acute.
				Chronic.
	{	Polyarticular.	{	Acute.
				Subacute.
				Chronic.

I. Acute Monarticular Gonorrhœal Rheumatism.—This is the most frequent variety. It begins in an acute manner, or is preceded by *malaise* and pain in several joints. Following rapidly upon this is a swelling of one of the larger joints, generally the knee. The pain is sometimes severe and sometimes slight. The exudation and tension within the joint are marked, and fluctuation distinct. The fever reaches 99.5° to 102° , and continues for some days. It is more marked in the sero-purulent than in the serous and sero-fibrinous varieties, and is attended with greater local manifestations of tension, pain, œdema, and redness of the skin. In the milder varieties of the serous, sero-fibrinous, and sero-purulent exudations resolution takes place in several weeks, provided complete rest be maintained and no increase in the urethritis occurs. Constant recurrences in the joint lead to the development of a hydrops, a papillary synovitis, or a condition pathologically resembling arthritis deformans.

A rare result of the acute variety is suppuration. This is made known by the chills and fever, together with the increased swelling, œdema, and redness of the joint. The pain usually changes to a throbbing, pulsating variety. Finally, the capsule is involved, and pus, escaping into the sheaths of the tendons and intermuscular spaces, perforates the skin. The result of this form is either recovery, with ankylosis, or pyæmia.

II. Chronic Monarticular Gonorrhœal Rheumatism, Hydrarthrosis, Gonocèle.—The chronic form develops either as a primary affection or is an outgrowth of the acute variety after many recurrences. In the former instance a gradual increase in size of the joint takes place, which is discovered by the patient quite accidentally. The joint is painless upon pressure, and only when the fluid is in large amount is the function of the joint interfered with. In extreme cases the ligaments become loose and stretched, and an abnormal mobility exists. In milder cases only the extremes of flexion and extension are hindered. Although at times resolution takes place, it generally persists for months, with many relapses. This constant tendency to relapses results finally in producing a form of papillary synovitis or deforming inflammatory changes in the bones and synovial membrane similar in character to an arthritis deformans.

Constitutional symptoms and local manifestations beyond functional disturbances are occasionally present. It is the rule not to have subject-

ive symptoms. The variety is usually monarticular. It exists in the knee, ankle, and elbow.

III. Polyarticular Acute Gonorrhœal Rheumatism.—It develops rapidly, and is distinctly polyarticular at the onset. As the disease progresses it confines itself to a single joint, or to two or three joints. When two joints are involved they are frequently the same joints in opposite sides of the body. The number of joints involved is never so great as in articular rheumatism, nor do we find, as in articular rheumatism, a number of joints simultaneously involved. It is the rule in gonorrhœal rheumatism to have the joints involved consecutively.

The fever is usually moderate, subsiding within a few days, while the local lesion continues. During the remission a new synovitis often takes place with a return of the fever. This repetition may occur two, three, or four times. The effusion within the joint is more marked, and the swelling of the tissues about the joint is less distinctly evident than in articular rheumatism. This is strikingly the case except where the sheaths about the joint are involved.

The want of proportion between the constitutional reaction and the local lesions is diagnostic. When a single joint is involved the constitutional reaction is often entirely wanting. When several joints are involved they become so consecutively, and the constitutional reaction is only moderate. When, however, the sero-fibrinous or sero-purulent variety of inflammation is present in an attack, the constitutional reaction is increased in proportion to the degree of involvement. The joint lesions are more stationary than in articular rheumatism, where the shifting character of the lesions is diagnostic.

Resolution is more tardy than in articular rheumatism, and a secondary hydrarthrosis, rare in articular rheumatism, is common in gonorrhœal rheumatism. The excessive acid perspiration, as well as the peri-, endocardial, and pleuritic manifestations, are not so frequent as in articular rheumatism. It is characteristic of this variety to find in the successive attacks the involvement of the bursæ, sheath of tendons, the iris, or conjunctiva.

IV. Polyarticular Subacute Gonorrhœal Rheumatism.—Next to the acute this is the most frequent variety. The fever is not high (101°), and the local symptoms are slight.

V. Polyarticular Chronic Gonorrhœal Rheumatism is either an outgrowth of the acute or subacute variety, or it develops as a chronic process from the beginning. It is frequently followed by hydrarthrosis—i. e., a chronic serous synovitis—and less frequently by a papillary synovitis, or arthritis deformans in several joints.

Pathological Coincidences.—Besides the joints, other organic structures are involved in the secondary affections following gonorrhœa,

and among these the involvement of the spinal cord should not be overlooked. Such instances have been dwelt upon by Stanley, Hume, Fournier, Hayem, and Parmentier.

The two latter give six cases in which not only a rheumatism involved the joints, but in which affection of the spinal cord was noted. The disturbances seen resulted in an alteration of sensibility—as neuralgia, hyperæsthesia, and anæsthesia; or disturbances in motive power, as cramps and paresis—in addition, increased reflexes at the knee and atrophy of the muscles of the lower extremity, with hydrops of the joints.

Fournier agrees with Hayem, and describes a case exhibiting deformities in the joints of the fingers, increased reflexes, twitching of the lower extremities, and atrophy of the muscles of the forearm. Of the pathology of these cases we know absolutely nothing.

The involvement of the nerves has been dwelt upon by Fraenkel and Loeb, who consider it a rare complication to polyarticular rheumatism. Fournier has found the sciatic nerve involved in five out of thirty-nine cases, Scarenzio in two cases. Contagne has seen two cases of crural and inguino-serotal neuralgia, and Guthertz has seen one case in which the internal pudendal nerve was the seat of the neuralgia.

The involvement of the bursæ in gonorrhœal rheumatism can not be called a rare complication, as it is seen quite often in a moderate number of cases. The bursæ in front of the tendo-Achillis, and that beneath the os calcis, are the more frequently attacked. The bursa beneath the tuber ischii and the bicipital bursa are not so frequently attacked, although their involvement is by no means rare. Terillon has recorded two cases in which the psoas bursa was involved. This is certainly a rare seat. Pathologically the bursæ suffer the same changes as the joints.

The sheaths of tendons are commonly involved with the joints, though they may be affected alone. It is by no means infrequently seen that the sheaths of the extensors of the hand, the dorsal flexors of the toes, and the flexor pollicis, are involved with or without an accompanying inflammation in the joints over which they pass. Less frequently we find the sheaths of the biceps brachii and tendo-Achillis affected. Pathologically the changes in the sheaths are the same as in the joints.

In the serous variety the long swelling corresponding to the shape of the sheath, without redness and much pain, is characteristic. It is especially characteristic for this variety to resolve completely or to pass into a chronic condition of hydrops. In the sero-fibrinous variety the symptoms of pain and crepitation, with only slight tumefaction and redness, are diagnostic. This is the variety in which we expect to find adhesions of the tendon to the sheath, and a consequent inability to perform certain motions with ease. In the sero-purulent variety, the tumefaction, œdema, and redness are the marked symptoms, and in this variety,

if any result other than resolution occurs, it is an adhesion between the sheath and the tendon, or suppuration.

The muscles of the neck, especially the deltoid and those of the eye, are sometimes the seat of pain, which is present principally upon use of the muscles. The pathology of this condition is not known. Amyotrophia occurring in the course of gonorrhœal rheumatism is localized to the muscles close to the joint involved, and less frequently to those at a distance from it. Sometimes it exists in a general form. When localized to the muscles moving the joint involved, the consensus of opinion favors as a cause a reflex mechanism, rather than a myositis, or a terminal neuritis of the articular nerves. When general, it has been at times observed to exist together with a variety of spinal lesions; and Urdy, in 1878, Fournier, Hayem, Parmentier, Tibrier, and Strümpell class the amyotrophia as a symptom of the spinal involvement.

The cutaneous phenomena were first described by Seele in 1781, and subsequently have been studied particularly by Jullien, Phillips, Petrone, Mesnet, and Kuppel. They appear under the forms of urticaria, purpura, erythema nodosum, and multiforme alone; or in conjunction with joint inflammations. They are angioneuroses induced by the urethritis through the intervention of the vasomotor nerves.

The involvement of the eye in gonorrhœal rheumatism is generally associated with the polyarticular variety. It may precede or follow the development of the rheumatism. It may be the only evidence of the rheumatism, or be present and alternate with the joint disturbance. *Aquo-capsulitis*, an inflammation involving principally the membrane of Descemet, is the most common form. In this variety the cornea is transparent, more prominent than usual, and the conjunctiva is injected.

The fluid in the anterior chamber is cloudy, with at times a slight flocculent deposit upon the posterior surface of the cornea. Photophobia is mild or absent. The iris is not generally affected, and there is little or no pain. If the iris be involved (iritis) there is a radiate pericorneal infection, a contracted or deformed pupil, an abolition of the movement of the pupil, an effusion of lymph in the pupil, and a plastic deposit in the anterior chamber. These symptoms are more marked in the gonorrhœal than in the ordinary iritis. Photophobia, and ocular and peri-orbital pain, are well marked in iritis.

Fournier describes a conjunctival form, which appears as a simple conjunctivitis uniformly distributed over or marked at certain points of the conjunctiva. The secretion is scanty and muco-purulent.

These three varieties are rarely monocular; one eye is usually involved after the other.

They run a rapid course, subsiding in a few days. In rare instances they last for weeks, and are then very prone to relapses.

Of these three forms the conjunctivitis is the least harmful. Aquo-capsulitis is not grave, though troublesome. Iritis is alone liable to be attended with adhesions interfering with perfect vision.

The involvement of the endocardium and pericardium was first mentioned by Brandes in 1854. At present about forty cases are known where endocarditis and pericarditis, or both, existed. It is a rare complication, and is present with the rheumatism in other structures, or alone with the gonorrhœa. It is especially observed where a rheumatism complicates the urethritis. In eleven out of thirteen cases collected by Morel this was the case. The symptomatology does not differ from the endocarditis due to articular rheumatism.

In the fibrous tissues, the juncture of the fibro-cartilage of the nose and superior maxilla, the insertion of the ano-coccygeal raphé to the coccyx and the spinous process of the three lower lumbar vertebræ have been described as being especially sensitive to pressure for months (seven, to eight) after the cure of a gonorrhœal rheumatism. In addition to the above, the calcaneum upon its lateral and inferior surfaces have been observed by Jacquet in 1892 as enlarged and painful in two out of twelve cases. He ascribes it to an osteitis or an inflammatory process involving the calcaneum and the ligaments, and gives to this latter form the name of "pied blennorrhagique."

Diagnosis.—The diagnosis of gonorrhœal rheumatism implies the recognition of three conditions:

1. The existence of a gonorrhœa or a previous gonorrhœal affection, with persisting ulceration in the urethra, etc.
2. The presence of inflammatory lesions at a distance from the local lesion, which are most probably metastatic in character.
3. The objective local symptoms and course of the part involved, as well as the character of the constitutional reaction.

The rheumatism usually occurs during the first month (75 per cent). Less frequently it occurs during the second and third months (25 per cent).

It is customary to have certain joints involved, as the knee, ankle, shoulder, and wrist, together with the tendous sheaths overlying them.

These joints are involved one after the other, and the joint inflammation does not present the shifting tendency so characteristic of articular rheumatism.

From articular rheumatism it may be distinguished by the greater effusion within the joints and the slighter involvement of the parasynovial tissue, except in the sero-purulent variety. Resolution is tardy in gonorrhœal rheumatism, and hydrarthrosis is rare in articular rheumatism, but common in gonorrhœal rheumatism. The lack of proportion between the constitutional reaction and the local lesion is diagnostic. The fever

is commonly more moderate than in articular rheumatism, and it subsides within a few days, while the local lesion continues.

The excessive and acid perspiration, the endocardial, pericardial, and pleural manifestations are rare in gonorrhœal rheumatism; 80½ per cent of the cases of gonorrhœal rheumatism are combined with an involvement of the synovial sheaths of tendons, bursæ, iris, or conjunctiva. This combination is more or less diagnostic. There is a combination of symptoms and lesions occurring in syphilis which may be easily mistaken for a gonorrhœal rheumatism. I refer to that class of lesions reported by Schüster, in which, following urethral infection, one or more joints become involved, together with an iritis, endocarditis, and pericarditis, osteitis of calcaneum, os sacrum, tuberositas tibiæ, and sternum. This complex of lesions in which the joints, bones, and iris are affected renders the diagnosis of syphilis quite probable, and the mercurial treatment in the form of inunctions cures or ameliorates these complications.

Treatment.—There is scarcely any treatment which can be called effective for gonorrhœal rheumatisms. Quinine internally in the acute stage, and in the later stages corrosive sublimate and rest to the joint, have been much used. Salicylic acid, cold, and fixation of the joint are often used.

For the pain, antipyrine, .75 to 1 gramme twice daily, has been especially good in some cases for the pain.

Salol internally is now recognized as having a real but feeble action in the acute cases.

Locally, compression, massage, and cold have proved to be of use. Physiological rest to the joint or joints is important. When these measures are not successful in alleviating the local lesions, withdrawal of the fluid within the joint, with irrigation of the joint with solutions of 1 to 40 carbolic acid, or 1 to 1,000 or 1 to 5,000 of corrosive sublimate, are generally successful. In that variety in which the pathological changes resemble an arthritis deformans resection of the joint or joints may be performed in order to secure ankylosis in a better position. This, however, is best delayed until the osteitis rarificans has run its course and is in the stage of sclerosis.

The urethra is to be treated in all cases where a lesion still exists.

The best prophylaxis against the rheumatism is the rapid cure of the urethritis.

GONORRHOEA OF THE RECTUM, NOSE, MOUTH, EAR, UMBILICUS, AND AXILLA.

BY JAMES P. TUTTLE, M. D.

GONORRHOEA OF THE RECTUM.

THE rarity of gonorrhœa of the rectum in this country may be appreciated in some degree when we hear from men of such large experience as Drs. Bumstead and Van Buren that they have never seen a case. Keyes in his latest work does not even mention it; Dr. J. W. White devotes a few lines to it only to encircle its existence with doubt; Dr. Otis mentions it but to pass it by; and Dr. Kelsey, with his large experience in rectal disorders, declares as late as 1890 that he has never seen it.

The experience and opinion of such eminent men as these and others equally celebrated have caused many in the profession to question the existence of the disease, and until the discovery of the gonococcus by Neisser the negative side of the proposition could have been maintained; but since that day its existence can no more be doubted than that of urethral blennorrhagia.

The diagnostic and pathogenetic importance of this micrococcus is questioned by some, and will be discussed in another portion of this book. It suffices here to say that the gonococcus is not found in the discharges from any of the ordinary forms of proctitis. It has never been demonstrated in any instance where there was not confession or presumptive evidence of exposure to the virus of gonorrhœa either through auto-infection, pederasty, or sodomy. If the disease, then, be not specific in its cause it certainly is in its product, and by a tree's fruit shall you know it. The tree which produces apples is an apple-tree, and the disease which produces gonococci is gonorrhœa.

Imbued with this doubt, Bonnière in 1874 made some interesting experiments upon the different mucous membranes of the body with regard to their susceptibility to the gonorrhœal virus. Taking a patient with gonorrhœal ophthalmia and urethritis, he smeared the pus discharged from these infected regions upon the mucous membranes of the nose and anus. The nose showed no evidence of the disease, but on the second day evidences of infection were seen about the anus, and on the fifth day a muco-purulent discharge from the part was seen, with itching, burning,

and considerable pain upon defecation. He then injected the pus into the rectum through a hollow tube, but with negative results. After a very few experiments, in which microscopic examination was notably neglected, he formulated the following table and conclusions :

<i>Mucous Membranes susceptible to Gonorrhœa.</i>	<i>Mucous Membranes refractory to Gonorrhœa.</i>
Prepuce.	Rectum.
Urethra, especially the fossa navicularis and prostatic portion.	Pituitary membrane.
Excretory canals of glands of Littré.	Lachrymal canal.
Conjunctiva.	Body of uterus.
Anus.	Ejaculatory canals.
Mouth.	Seminal vesicles.
Prostatic utricle.	Deferent canal.
Vulva.	Prostatic canals.
Vagina.	Bladder.
Inferior portion of the cervical canal.	Excretory canals of the glands of Cowper and Bartholini.

Conclusions.—All the mucous membranes susceptible to gonorrhœa are covered with pavement epithelium, or are supplied with papillæ and a superficial sub-epithelial network of lymphatic vessels. The mucous membranes refractory to gonorrhœa are covered with cylindrical epithelium and have a superficial sub-epithelial network of veins.

These experiments are very interesting and point apparently to some important facts. They have been referred to and quoted by all authors arguing upon the negative side of the question since Bonnière published them ; but they are too meager to draw conclusions from at all, and the inferences which he assumes have only a comparative value. Admitting this assumption, that the mucous membrane of the rectum is refractory to gonorrhœal virus, nevertheless it does become infected and the symptoms are unmistakable.

The first account we have of this disease is said to be by Hecker, a Prussian physician, in his *Maladies vénériennes*, published in 1788. He there mentions a purulent discharge from the rectum which he had often observed in men and women, always traceable to unnatural coition. A German physician of the same name, writing in 1802, in a work on Tripper, speaks of gonorrhœa from hæmorrhoids. Goslin says, "I have seen one case of undoubted gonorrhœa of the rectum, but I have not seen stricture develop from it." Billroth says, "A very acute catarrh with profuse secretion results from the contagium of gonorrhœa to the mucous membrane of the rectum. It occurs in women most frequently from the inflowing

of the secretion from the vagina, but in men through direct infection in consequence of passive pederasty."

Rollett says he has frequently seen it, and reports the very interesting case of a man who, being habitually constipated, was in the habit of introducing his finger into the rectum to assist in defecation. Being attacked with gonorrhœal urethritis, he carried some of the pus upon his finger into the rectum and set up a virulent gonorrhœa of that organ.

Allingham says he has seen three undoubted cases of gonorrhœa of the rectum, but, considering it a well-established fact, does not give a minute description thereof. Thiéry reports a case with sodomic history, infundibuliform anus, crased mucous folds, relaxed sphincters, profuse purulent discharge, red and swollen mucous membrane, excoriated and ulcerated in patches.

Dr. Winslow reports two cases, in an institution for boys near Baltimore, which were the source of endemic gonorrhœal urethritis in the institution. Most of the invalids confessed to pederasty, and the disease was finally traced to a boy whose urethra had become infected while on leave of absence, and who had practiced active pederasty on one of the smaller boys upon his return to the school.

Martineau reports two undoubted cases of the disease, one a sodomist and the other a pederast, and at the same time quotes a case of Tardieu's.

Bernard and Tardieu say that they have frequently seen the disease in boys and adults who were always the victims of pederasty. L. Jullien, in the last edition of his work, *Sur les maladies vénériennes*, gives an accurate and full description of the disease up to that date.

These writers, however, based their opinions upon subjective and circumstantial evidence. Microscopic examination bore no part in their diagnostic methods. As soon, then, as the discovery of Neisser was made known, all these observations went for naught until they should be verified by the discovery of the gonococcus in a certain number of cases. This has been done; the micrococcus has been identified beyond question in anal and rectal discharges, and that, too, in cases the symptoms of which coincided as accurately as possible with those of the cases reported as cases of rectal gonorrhœa by the observers quoted above. Thus are the judgments of our predecessors confirmed by the methods of precision in medicine at the present day, and the cloud which once rested over them is dissipated forever by the microscopic demonstration of the identity of the discharges in urethral and rectal gonorrhœa.

Neisser has observed two cases of rectal gonorrhœa in married women. Their husbands were examined, and found to have the disease in their urethras. Microscopic examination of the secretions showed gonococci similar in quantity and quality to those in their husbands.

Bumm quotes a case observed by M. Wolf in the Würzburg Clinic for Syphilis. The woman suffered from a sanguino-purulent discharge from the rectum, which she said had begun a few days after sodomic intercourse. The rectal mucous membrane was swollen, deeply reddened, painful, and inclined to bleed. The discharge was shown by the microscope to contain numerous gonococci. There was no coexisting gonorrhœa of the genital organs.

Merk is reported to have observed a case in Landschut in 1888, but no satisfactory microscopic examination was made, and altogether the case appears more like tubercular ulceration than gonorrhœa of the rectum.

The most thoroughly observed case so far, however, is that of Dr. Matterstock, of the Würzburg Clinic for Syphilis, and reported by Dr. F. Frisch.

A girl, seventeen years of age, fifteen days after her last coitus, complained of pain and burning in the rectum, unbearable at defecation. She confessed to having frequently practiced sodomy. Examination showed a funnel-shaped anus, "the parts around were deeply reddened and there was a partial loss of epithelium." The swelling about the parts left only a small opening in the anus, through which dribbled a thick, greenish-yellow secretion. Microscopic examination showed squamous and cylindrical epithelial cells and abundant pus-corpuscles, many of which contained typical gonococci. Now and then a pus-cell appeared in the field which was literally stuffed full of gonococci, so that the nucleus instead of presenting the usual irregular oval shape was more crescent-shaped. Many round lumps of gonococci were seen in the neighborhood of these pus-corpuscles. A similar exhibition of gonococci was found in the discharges from the genitalia. The patient developed pulmonary tuberculosis and died from this disease before the gonorrhœa was cured.

Upon post-mortem examination of the part, the large polynuclear round cells were seen stuffed full of typical Neisserian gonococci. Here and there was seen the swarming of the gonococci as mentioned by Neisser. The tubes of the glands and Ehrlich's rectal cells were also found to contain gonococci.

This is one of three cases reported with tubercular complications, and all of them have been obstinate in yielding to treatment, a fact which entirely corresponds with my experience in urethral gonorrhœa.

Add to these the three which I have myself reported and I believe we will have proved the diagnosis and opinions of those who, laboring before the discovery of Neisser, yet recognized gonorrhœa of the rectum and treated it as such.

Etiology.—The cause of this disease is the direct infection of the

mucous membrane of the rectum or anus by the gonorrhœal virus. This may be brought about by the extension of the disease from the vulva to the anus, and thence to the rectum, in women; by careless handling of the parts affected with the disease and thus conveying its germs to the rectum, as reported by Rollett; or, as is most frequently the case, it may be produced by unnatural coitus, the active party being affected with the disease. I believe the disease is due to local inoculation with the virus, and have no faith in the metastatic theory.

Symptoms.—The first symptoms of gonorrhœa of the rectum are itching, tingling, and a sense of heat which may appear at any time from twenty-four hours to ten days after exposure to the disease. The heat soon grows to a burning, the itching into pain, defecation becomes agonizing, and a dull, heavy aching in the sacral region appears, if the attack is severe. At this time, from the fifth to the seventh day, the patient will probably have some constitutional disturbance, the pulse being rapid, the temperature elevated, and general *malaise* will supervene. The pain incident to defecation causes that function to be neglected, and the tongue soon becomes coated, the appetite disappears, and the patient shows signs of serious illness. After two or three days a discharge appears, at first thin and milky-white, but later thick, greenish or brownish-yellow, and very abundant in quantity. The appearance of the anus will depend on the habits of the patient. If a passive pederast or sodomist, the anus will be more or less infundibuliform, its folds obliterated, the sphincters relaxed, and the mucous membrane swollen, hot, and shining. There will be no hæmorrhoids, but probably numerous little fissures, and occasionally a sub-mucous fistula. If the patient be not given to these practices, the anus will be swollen and pouting; the mucous folds about its border will be inflamed, enlarged, and œdematous; at their bases, between two folds, the muco-cutaneous tissue will be bathed in pus, excoriated or ulcerated, thus forming anal fissures which are very painful. The disease may not, indeed does not, usually extend above the internal sphincter. When it does, the mucous membrane of the rectum becomes swollen, brightly red, extremely painful, and bleeds easily upon touch; the whole is bathed in a profuse secretion of thick muco-pus which dribbles from the anus, imperfectly closed on account of the swollen folds. Here and there, there are patches of excoriated or truly ulcerated surface. The disease, especially if confined to the anus, is easily cured by simple cleanliness; but if it has invaded the rectum, it is less amenable to treatment, and may become chronic; there will then be points of chronic ulceration and cicatricial healing on the mucous membrane.

Erythema, ulcerations, condylomata, fissures, and even fistula may be found about the borders of the anus, and sometimes the disease is so severe as to produce dysuria. “The scars and ulcers seen in the chronic

form are difficult to distinguish from syphilitic proctitis as well as from tubercular forms of rectal disease."

The symptoms, which in the majority of cases are not severe, may pass away rapidly under the ordinary attention to hygiene and cleanliness. Indeed, I believe the large majority of them are never seen by the profession, owing to this fact. But in careless individuals, and in those cases where the rectum is invaded above the external sphincter it may continue indefinitely, if left untreated.

Diagnosis.—The diagnosis of this disease is not often difficult in women, thanks to the usual coincidence of gonorrhœa of the genitalia; but in men it is sometimes far from simple. I have seen one case in a man in which the discharge was so slight, the inflammation so insignificant, and the general symptoms so indefinite, that I was unable to distinguish the case from catarrhal proctitis until I had made an examination of the pus, and found gonococci therein. The existence of gonorrhœal disease elsewhere, the history of pederasty or sodomy, are necessary to the positive diagnosis. Of course, if gonococci, typical in character, number, and arrangement, be found in the discharges, all doubt is put at rest.

The method of collecting the pus for these examinations in order to distinguish between the anal and rectal forms of the disease is important. The anus is wiped off as gently and as thoroughly as possible with absorbent cotton, and then washed with a solution of salicylic and boric acids—Thiersch's solution. A cylindrical speculum such as my own or O'Neil's is then introduced closed, and the sliding bar on the upper side withdrawn, the patient lying on the left side. The specimen is then taken from the surface of the rectum, and not from the discharge which flows down into the speculum, lest by any chance some of the secretion from the anus should have been carried up on the end of the speculum. Several specimens are then examined, to corroborate one another, and to avoid as far as possible the error of mistaking disease of the anus for that of the rectum. The solutions used for staining in these cases are gentian violet and ammoniated carmine, and the results are practically the same with both.

But gonococci may not be found, and still the case be gonorrhœa. Blake and Shulldham tell us that, "when gonorrhœa has reached the chronic stage we may fail to find the diplococci or true gonococci, but encounter instead pseudo-cocci, staphylococci, streptococci, or tubercle bacilli." We should therefore not stake our diagnosis upon finding these bacilli, but look upon them as corroborative evidence of an opinion formed otherwise. The history of the case, then, the appearance of the anus, exceedingly relaxed or spasmodic according as the patient is or is not a sodomist, the amount of the discharge, which is usually profuse,

the pain upon defecation or examination, the fissures between the anal folds, the absence of tubercular or nephritic complications, which both produce ulceration in the rectum similar to gonorrhœa, and the presence of the gonococci free or in the pus-corpuscles, will establish our diagnosis of the disease.

Intertrigo is liable to be confounded with gonorrhœa of the anus, but the history of the case, the presence of gonorrhœa elsewhere, and the detection of gonococci, will easily distinguish them.

Prognosis.—The disease tends toward a mild course, and rapid recovery in otherwise healthy individuals. If, however, there be a tubercular diathesis, local manifestations of this disease are likely to occur during the attack of rectal gonorrhœa, and so far as I have been able to learn, this complication is nearly if not always fatal.

Treatment.—Anal gonorrhœa, if the parts are kept clean and protected from chafing one another, will disappear spontaneously in the majority of cases. When the disease has progressed to the inflammatory, excoriated, or ulcerated stage, or when the rectum has been involved, active and energetic measures are requisite. In the first stage the parts should be bathed gently two or three times a day with a cold saturated solution of boracic acid. Some prefer solutions of bichloride of mercury, but I have not found them so efficacious. Lime-water acts very well as a bathing solution. After the parts have been dried with a soft cloth, a powder of oxide of zinc and calomel, equal parts, should be freely applied, and the buttocks separated by a fold of patent lint or plain absorbent gauze. Jullien advises the use of tannic acid in place of the above powder, but it is too irritating, and does not hasten the cure.

If the peri-anal cutaneous surface is inclined to take on an erythematous irritation, keeping it thoroughly greased with vaseline will do much to check it. In case of ulceration, either upon the muco-cutaneous surface or in the cracks between the anal folds, the application of pure carbolic acid or a concentrated solution of nitrate of silver should be made before applying the powder. This treatment, together with gradual dilatation of the sphincter, is applicable to the cases in which fissure exists; but if fistula have occurred, it should be treated at once so that it can not act as a hiding-place for the micrococci, from which they can break forth and reinfect the parts, after they have been virtually cured. As these fistulæ are usually of the sub-tegumentary variety, involving only the mucous and muco-cutaneous tissues, they may be effectually cured by laying them open and cauterizing them under cocaine. Condylomata may be snipped off with the scissors, but a better method is to touch them a few times with a fifty-per-cent solution of mono-chloracetic acid, and apply the powder of zinc and calomel.

When the disease has invaded the rectum proper, the regulation of the bowels, and the thorough irrigation of the rectum with appropriate solutions, will be all that is necessary. I have found the saturated solution of boracic acid to be perfectly satisfactory. The method of using this as an irrigation, and not as a simple injection or enema, is much more effectual. I am in the habit of using my rectal irrigator (Fig. 1). by which the rectum can be distended, and all the cracks and folds of the organ thus reached and acted upon. It also has the advantage that it can be used in bed without soiling the clothing, or inconveniencing the patient, a feature not particularly necessary in these cases, but of great moment in other diseases of the rectum. One to three quarts of this solution should be used at each sitting, and a cure may be confidently ex-

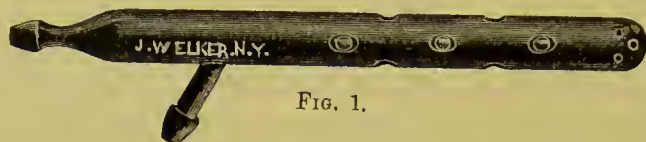


FIG. 1.

pected in seven to ten days. I have used the mild solutions of bichloride of mercury, but they did not act so pleasantly upon the patient or result in so prompt a cure.

If the mucous membrane of the rectum be ulcerated from the gonorrhœal inflammation, applications of strong solutions (50 to 150 grs. per ℥j.) of nitrate of silver, or equal parts of carbolic acid and tincture of iodine, may be applied to the ulcer after the irrigation has washed away the muco-pus covering the parts. A regular, well-formed stool is desired once or twice a day, in order that the rectum may not become loaded and irritated with either hard or fluid fecal matter. To this end I have found nothing so effective as the following pill:

Aloin, resinæ podophylli, āā gr. $\frac{1}{8}$; extracti belladonnæ, gr. $\frac{1}{4}$; extracti colocyntidis co., gr. j; fiat in pil. No. 1. Sig.: One or two at bedtime.

The irrigation and treatment should not be discontinued until eight or ten days after the discharge has ceased, for the micrococci are liable to become concealed in Leiberkuhn's follicles, and the discharge begin anew after several days. Care and patience are necessary to treat these cases thoroughly; and the class in which the disease is likely to be met with offer us little to hope for, either in fees or gratitude.

GONORRHOEA OF THE NOSE.

This disease, although its existence was recorded in the last century, has received no thorough study in recent years. Bonnière, reasoning from one experiment and the character of the epithelium of the organ, includes the pituitary membrane among those refractory to the gonor-

rhœal virus. The experiment is insufficient, and the reasoning from analogy will not bear the burden of the conclusion, for the epithelial arrangement about the nares is almost identical with that about the anus, and we have shown beyond question the existence of the disease there. However, the rarity of the disease and the absence of the demonstration of the gonocœci in the discharges justify the doubt of its existence. Andrew Duncan has reported the case of a young man who, suffering from a severe gonorrhœa, was obliged to use his handkerchief for a short time as a protection against soiling his shirt. After obtaining other cloths he imprudently put it into his pocket, and, without being aware of the consequences, used it for wiping his nose. The result was a disease of the inside of the nose and an affection of the mucous glands there, in every respect resembling the gonorrhœa of the urethra. Hecker says: "If the contagious material should penetrate accidentally into the nose or ear it will occasion a discharge from these parts. This gonorrhœa, which one may call auricular or nasal, according to its seat, is soon cured by cleanliness alone." He does not, however, describe any case or mention having seen them. A. M. Edwards has reported the case of a woman laboring under a severe ulcerative catarrh of the mucous membrane of the nose. She claimed to have used, some six months previously, a handkerchief which had been used by her son, who was at the time suffering from gonorrhœa. It is not stated how soon after the use of the handkerchief the discharge had begun, but the writer infers that the disease was due to the contagium conveyed through the handkerchief.

Already the theory of metastasis, advanced by St. Ives, had been applied to the nose, mouth, and ear; and Jullien quotes the case reported by Forceades as due to this cause and cured by reproducing the urethral catarrh. In the light of modern research there is absolutely no foundation for such a theory.

Lefferts describes gonorrhœal coryza as "aggravated, purulent, catarrhal inflammation arising in children from infection through the mother at birth, and in adults from the direct conveyance of the virus to the Schneiderian membrane by the fingers, soiled pocket-handkerchiefs, etc." He does not, however, cite any cases or refer to any as authenticated.

Stoerk describes chronic blennorrhœa of the nose as occurring among the Polish Jews in Galicia, Poland, Wallachia, and Bessarabia, a people living in poverty and filth, and who attach little importance to personal cleanliness. In the first stage there is a profuse secretion of greenish-yellow pus and the "vascular injection and succulence met with in acute catarrh" or coryza are absent. The disease is prone to extend downward, involving the pharynx, larynx, and vocal cords. Induration and matting together of the soft tissues occur in the disease, but the cartilages and bones of the nose and throat are never involved.

Kolbe reported two similar cases, and one communicated to him privately by Dr. Herring, that of a medical student who suffered from a chronic nasal blennorrhœa occurring during an attack of urethral gonorrhœa. Dr. Kolbe does not say positively that his cases were due to gonorrhœal virus, but that he believes such to be more than likely the case, for, says he, "I have seen with my own eyes a patient suffering from a profuse leucorrhœa, preparing for an examination, use her pocket-handkerchief to cleanse both her nose and her vagina, and who can draw the line between leucorrhœa and blennorrhagia?" In the light of the positive knowledge of the present day, it would have been a simple matter for Kolbe to decide whether this disease was gonorrhœal or not. Its history, course, and subsequent results are certainly in the line of gonorrhœal affections, and I have hoped and looked in vain for some report of the accurate microscopic examination of these cases which would prove the origin, cause, and pathology. Until such has been made, we can only surmise and believe in the existence of the disease on clinical symptoms, if at all. If gonorrhœal ophthalmia be once established, I can not see any reason why the virus should not travel down the lachrymal ducts and thus infect the pituitary membrane, or why the virus is not more likely to be carried by handkerchiefs and cloths from the eye to the nose than from the urethra to the eye. While I have not seen such cases, I believe that they are not only possible but probable in the class of patients described by Kolbe and Stoerk, and we will yet see the gonococcus demonstrated in these cases.

GONORRHŒA OF THE MOUTH.

The arrangement of the epithelium of the mouth being so similar to that of the urethra, and the knowledge of the practices of Sapphism, would lead us to expect more frequent cases of the disease in this organ than in the nose. Hölder, after stating that the affection is due to direct infection of the mouth by gonorrhœal pus, either through contact with the genital organs or transmission by the hands, goes on to quote a case from Petrasie, of Kiel, which seems incontrovertible.

Vidal quotes from Baumes the case of a man who, having kissed the vulva of a woman, was attacked with buccal blennorrhagia.

More recently, Cutler has reported a case with such positive history and evidences of gonococci that it deserves special notice. Rizat and Fournier have reported cases of this disease; and Delefosse and Horand have reported cases of urethral gonorrhœa contracted *ab ore*.

M. Dohrn has reported five cases in children in which the presence of the gonococci were demonstrated by the microscope and verified by culture. The existence of the disease is therefore no longer in question.

Etiology.—Menard has reported four cases of what he terms

“gonorrhœal ulcero-membranous stomatitis.” The patients had all suffered from gonorrhœa of the genital organs and complications, such as orchitis, epididymitis, and arthritis. In accordance with the teachings of Bonchard and Capitan, he holds that the disease is due to the profound infection of the system with gonorrhœal virus; that it always succeeds other complications of gonorrhœa; that it is accompanied by constitutional disturbances; and that it is a systemic not a local disease.

While there is no proof that the coccus may not circulate in the lymph or blood, thus migrate to remote organs, and there finding a congenial soil reproduce the original disease, its presence in these fluids must be demonstrated beyond a doubt before we can accept such a theory. Moreover, even then if confined to the mouth it would still be a local disease, and would not alter our firm conviction that gonorrhœa wherever found is the result of direct inoculation of the part by the gonococcus, regardless of the mode of its conveyance thither. In the new-born it results from inoculation through the mother at birth; in adults from the vile practices of Sapphism, or careless and uncleanly habits during attacks of gonorrhœa of the genitals.

Symptoms.—The first indication of the disease appears very soon after exposure to contagion, usually within twenty-four hours. The first sensation is that of a raw, dry feeling in the mouth, accompanied by a disagreeable taste to the saliva. This is followed by a sense of burning, the mucous membrane becomes red, the gums swell, become soft, and recede from the teeth. On the third to the fifth day herpetic sores break out on the lips; the tongue and buccal surfaces as far back as the fauces become swollen, painful upon motion, and bleed easily. Here and there will be seen patches of a grayish-yellow pseudo-membrane, which being detached leave excoriated or ulcerated surfaces. An abundant mucopurulent secretion exudes from the parts and dribbles from the imperfectly closed lips. Deglutition is very painful, the appetite is lost, the pulse rapid, and temperature elevated. The disease does not appear to extend beyond the faucial arch, but the sublingual, parotid, and lymphatic glands about the part usually swell and become painful. So far there is no history of these glands suppurating, but it is altogether within the range of possibilities.

Diagnosis.—The only disease with which this affection is likely to be confounded is stomatitis in its various forms. In the new-born stomatitis develops at a later date than buccal gonorrhœa, the inflammation is less severe, and there is no purulent secretion from the mouth. In adults the history of the case, the absence of exposure to contagious stomatitis, the swelling of the glands, and the presence of gonococci in the pus and membranes, will distinguish buccal gonorrhœa from any other disease.

Treatment.—The treatment of this disease is based upon the same

principles as that of urethral gonorrhœa. Antiseptic washes, such as solutions of boracic acid, fifty per cent, carbolic acid, two and a half to five per cent, or bichloride of mercury, one to two thousand, are used frequently during the day. Together with these, astringent applications, such as the saturated solution of alum, tannate of glycerin, or nitrate of silver, ten to twenty-five per cent, are made, and serve to reduce the inflammation and restore the power of deglutition. Chlorate of potash and many other remedies have been tried, but the results do not encourage their use. Under the above treatment the disease will usually succumb in seven to fourteen days, but the treatment should be continued for some days longer to insure its eradication.

GONORRHOEA OF THE AXILLA, EAR, AND UMBILICUS.

Of blennorrhagias in these anomalous situations little need be said. They have not been verified by the modern methods of research, and literature does not furnish us with sufficient authenticated cases of the disease in these parts to establish its undoubted occurrence.

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STRICTURE OF THE URETHRA.

By J. WILLIAM WHITE, M. D.

CONGENITAL STRICTURE.

STRICTURE of the male urethra may be *congenital* or *acquired*. Congenital stricture is rare, and is usually confined to the meatus or to its immediate vicinity. The cases of atresia of the meatus sometimes reported as congenital are often the result of infantile balano-posthitis caused by a long and adherent prepuce with a narrow orifice. In the cases said to have been observed by Nélaton (Delfau, *Maladies des voies urinaires*, Paris, 1880, page 241), the contractions were situated in three patients in the penile urethra and in one at the bulb. The six cases included by Thompson in his table of two hundred and twenty cases (Stricture of the Urethra, page 224) were only presumptively of congenital origin. An interesting case is reported (Jameson, *Epitome of Practical Medicine*, April, 1887, page 189) in which three congenital contractions were said to exist in a boy of ten, plainly perceptible to the touch externally, and necessitating operation.

I am not familiar with any similar cases of undoubted authenticity.

Narrowing of the meatus, reducing it almost to pin-point size, may exist from birth, giving rise to no appreciable symptoms, and often no surgical opinion is procured in reference to it until an attack of urethritis during adult life obliges the patient to seek advice. Such cases are frequent enough to make one doubt the accuracy of these definitions of stricture which include *all* encroachments upon the average normal urethral caliber and ignore the associated pathological conditions. Such a congenital stricture should be operated upon without hesitancy when any urinary symptoms appear, or when it interferes with the proper exploration or treatment of the urethra or bladder; but the tendency of late years has been rather to overrate the clinical significance and importance of narrowings of the meatus and to divide the latter with unnecessary frequency and freedom. An artificial balanic hypospadias is often thus produced, which leaves the patient with a diminished power of ejection of both urine and semen.

ACQUIRED STRICTURE.

Definition.—Acquired stricture includes all other forms than those above mentioned, and may be defined as an abnormal lessening of the caliber or dilatability of the urethral canal associated with changes in the mucous, submucous, or muscular structures constituting its walls* (An American Text-Book of Surgery, page 882). This definition includes the following chief varieties of stricture: (1) Inflammatory; (2) spasmodic; (3) organic—*a*, of large caliber; *b*, of small caliber.

Inflammatory Stricture.—The term inflammatory stricture is objectionable, as tending to confuse a passing condition and one merely symptomatic of ordinary processes of inflammation with a definite and permanent lesion of much more importance.

The existence of inflammatory stricture has been denied by eminent authorities, who assert that without congestion of the prostate, spasm of the circular muscular fibers of the urethra, or pre-existent organic stricture, no swelling of the mucous membrane alone is competent to give rise to retention of urine. While I believe this to be true, it can not be disputed that occasionally in cases of acute anterior urethritis, with no suspicion of previous stricture and with the prostate unaffected, we have great diminution in the size of the stream of urine, manifestly from the unnatural approximation of the swollen urethral walls. Although the condition is almost always of short duration, and never goes on to retention, it is often the first step in the formation of organic stricture. The treatment is that appropriate to the form of urethritis in question. If, as has been recently suggested (Culver and Hayden, page 88), the term inflammatory stricture were dropped and we spoke merely of the actual condition present in such cases—viz., an acute catarrhal inflammation with recent soft exudation into the mucous and submucous tissues—our nomenclature would be simplified and improved.

Spasmodic Stricture is the result of a contraction of the circular muscular fibers of the urethra, either the unstriped or the compressor urethræ. This is usually reflex, but is sometimes the result of psychical causes, as shame, fear, anger, etc. In the former variety, which is of most surgical importance, it usually depends upon reflex irritation transmitted from some point of irritation in the urethra itself, as from an organic stricture or a patch of granular urethritis in the penile urethra or near the bulb. More rarely it arises from reflex irritation from a greater distance. The retention of urine which often follows surgical operations, especially those upon the anus and rectum, is probably as often

* Sir Charles Bell defined it as a loss of elasticity, which would exclude both the spasmodic and inflammatory varieties.

the result of vesical inhibition as of urethral spasm, although it is usually attributed to the latter. Sehatz (*Centralblatt für Gynäkologie*, June 16, 1888) has, however, called attention to a method of relieving the retention of urine which sometimes follows parturition, which consists in introducing into the bladder an instrument like a glove-stretcher, and dilating the sphincter vesicæ and the urethra so that the tip of the little finger could be inserted. He found this almost invariably gave permanent relief. As the condition is similar to the retention above spoken of, it offers an argument by analogy in favor of the theory of spasm.

Spasmodic stricture is also often thought to depend upon a narrowing of the meatus, and large numbers of cases have been reported in which more or less persistent spasm was attributed to this cause and relieved by meatotomy. It must be remembered, however, that spasmodic stricture is particularly apt to occur in nervous, excitable, irritable young men, allied in type to hysterical women, and that in such patients any marked mental impression often causes a disappearance of existing symptoms. Davenport (Keyes, *Genito-urinary Diseases*, page 101) records a case in which all the symptoms of deep urethral obstruction existed for ten years, and were relieved immediately and permanently by a single catheterization, a result which would doubtless have been attributed to a meatotomy if that operation had been required as a preliminary.

I was at one time an earnest believer in the frequency of urethral spasm as a result of a small meatus, or a large anterior stricture, and I still believe in its possibility. I have seen and reported (*Philadelphia Medical Times*, 1877) cases which seem to admit of no other interpretation, but I am now satisfied that many cases, in which I then attributed the improvement in my patients to the meatotomy or urethrotomy which was performed, would have been equally benefited by the passage of a good-sized sound through the deep urethra. If the meatus or the anterior contraction is too small to admit such a sound, a cutting operation is, I think, clearly indicated in the presence of otherwise inexplicable urinary symptoms, such as frequent micturition, "urinary stammering," urethritis, etc., but I certainly do not see among my patients to-day the same proportion of cases which in my judgment require cutting operations as I did some years ago. Keyes (*Annual of Medical Sciences*, 1888) has arrived at the same conclusion, as have many other genito-urinary surgeons. Guyon (*Leçons cliniques*, Paris, 1881) says that he has never detected membranous spasm in simple relative atresia of the meatus, but does not deny its possibility.

Organic Stricture may occur in persons of any age, but is most frequent between twenty and forty-five. Women are not entirely exempt. McIntosh and Carter have given extensive statistics, derived from the records of the United States Marine Hospital Service, to show that gon-

orrhœal strictures of the urethra occur much less frequently in negroes than in white men in proportion to the number of cases of gonorrhœa; they conclude that in negroes the ratio is about one stricture to twenty-three gonorrhœas; in white men about one in eight. These observations have not been repeated, so far as I know.

The great majority of such strictures result from a precedent urethritis or from traumatism. The former is by far the more common cause. It acts in a manner easily understood, and is more potent in direct proportion to its duration. Its intensity is of some but of minor importance. Of 164 cases due to urethritis, 90 were reported to have been of long continuance. Inflammation of the urethra is peculiarly apt to run into a chronic form for several reasons. The canal affords periodical passage to a secretion, the urine, which is especially liable, by reason of changes in its constitution, to become an actual irritant; it is exposed, at times of erection, to intense congestion of all its vessels, and the converse is also true, a congested or irritated spot along the urethra predisposing to erection; gravitation, the proportionately excessive supply of blood to the region, and the absence of extravascular resistance due to the loose character of the spongy tissue, all favor the persistence of any congestion left after a first attack of urethritis; the condition of approximation of mucous surfaces, as of the urethral walls during the intervals of micturition, is here, as elsewhere, unfavorable to the disappearance of granular or injected areas, or other traces of inflammation. The tendency of the gonococcus to establish itself in the deeper layers of the mucous lining, and to multiply there where it is comparatively inaccessible, is another cause of the frequent occurrence of the chronic forms of urethral inflammation.

In chronic granular urethritis the urethral epithelium becomes so damaged at one or more spots, as a consequence of the prolonged inflammation, that it permits the escape of minute quantities of urine into the tissue comprising and surrounding the urethra. Harrison has well summarized (Lettsomian Lectures, 1888) the resulting changes: To prevent urine soaking farther into the tissue, inflammatory exudation is excited, and barriers of lymph, which ultimately become organized, are thrown out opposite the places where the leakages take place. Thus, splints of plastic tissue are formed, corresponding with the spot or spots where the epithelium has been so damaged by persisting inflammation as to cease to discharge its normal function. In this strengthening of the urethra we recognize, in the first instance, a conservative action; eventually, however, as in other compensating processes, certain inconveniences follow which constitute, as it were, an independent disease. In addition to the careful observations which have been made relative to the pathology of gleet and the changes that are induced by chronic inflammation in the

epithelial lining of the urethra by Dr. Oberländer, of Dresden, there are other considerations which seem to indicate that an excessive form of plastic exudation in the tissues around the urethra is probably excited by the interstitial leakage or exosmosis of some of the constituents of the urine through the walls of the canal.

Among those mentioned by Harrison are: 1. That though the mucous membrane is the tissue chiefly involved in the primary inflammation, it is, as a rule, only secondarily implicated in the stricture-forming process. In many instances it will be found after death that the dimensions of the mucous membrane are not permanently altered, and that it is possible to split a stricture without necessarily damaging the lining membrane of the canal. 2. That the plastic exudation which makes up a stricture differs from other exudations provoked in other parts of the body by inflammation in the degree of its density and tendency to contract. 3. The character of the cicatrix which is formed in connection with ruptures and lacerations of the urethra unmistakably shows the effect produced in the healing process of a recent wound, which is constantly submitted to the action of more or less pent-up urine. Here we have a cicatrix which of all strictures is the most resisting and contractile.

Further, the form in which stricture tissue is deposited, and ultimately exercises contractile pressure on the urethral passage, is strongly suggestive that in the first instance it served the purpose of strengthening the wall of the canal, and thus preventing the further leakage of some of the constituents of the urine from taking place at points where the epithelial coat had been more or less permanently damaged. Most strictures are the result of organized lymph which has been deposited in the submucous tissue in an irregular form. An annular stricture is comparatively rare, except when due to traumatic causes—such, for instance, as an injury to the whole caliber of the urethra.

Oberländer, whose views have been alluded to above, thinks that he has demonstrated the existence of two chief forms of chronic urethritis: 1. That in which the infiltration of the mucous membrane is diffuse and superficial and the glandular elements are not involved. 2. That in which the glands of Littré are markedly affected. He describes several subdivisions of this variety, giving to the form which ends in extensive cicatricial bundles projecting high above the level of the mucous membrane the name *urethritis glandularis stringens*, as it is this condition which, according to him, results in stricture.*

Nelson has confirmed these views by a long series of autopsies, which show that the glandular affection is extremely persistent and easily recog-

* See an excellent *résumé* of Oberländer's views by Fordyce, Jour. of Cut. and Gen.-Urin. Dis., January, 1889, p. 19.

nizable even when cadaveric maceration has destroyed the evidence of change in the mucosa and of epithelial proliferation.

Bryson, in an admirable paper (*Journal of Cutaneous and Genito-urinary Diseases*, June, 1889) calls attention to the fact that a definition which makes of stricture a mere mechanical narrowing of the canal includes conditions which no one regards as stricture in the true sense of that term, such as polypi, warty growths, periurethral tumors or abscesses, etc. He thinks that the definite characteristic of stricture is its persistent tendency to become more dense and to contract toward the axis of the affected canal. This excludes narrowings, the essential difference being that in the latter condition we have overlying healthy mucous membrane. He suggests the name of "chronic contracting periurethritis" as accurately describing the "stricture disease," in which we have the changed condition of the mucosa as the essential though passive factor and the urine leakage as the active element. Further evidence in confirmation of this view is furnished by what Mr. Buxton Browne calls "catheter stricture," a form of stricture not usually mentioned in text-books, but which in actual practice causes a great deal of trouble, and even danger. It occurs in elderly men obliged to use the catheter constantly, in many cases appearing to be due to want of care in the selection and use of the catheter. About five or five and a half inches down the urethra the walls of that canal appear to be in a state of spasmodic contraction and inflammation, the mucous membrane loses its polish, and doubtless a certain amount of inflammatory deposit takes place. This condition occasionally occurs in cases where, previous to the introduction to catheter life, lithotripsy has been performed for vesical calculus, and the urethra has been accidentally lacerated; while in other cases it has followed the prolonged employment of an India-rubber catheter, which, as the result of frequent use, had become eminently adapted for rubbing the epithelium off the walls of any narrow portion of the urethra and irritating them into a state of contraction.

As a rule, the processes of urine leakage and of stricture formation extend over a considerable time. Thompson found that, in 164 cases, 71 occurred within a year, 63 in from three to eight years, 20 in from eight to twenty-five years, and only 10 soon after the subsidence of the urethritis.

Guyon, in 83 cases, found that 24 appeared in from one to two years, 14 in from two to four years, 29 in from four to ten years, and 16 in from ten to fifteen years or later.

Traumatic Stricture follows blows upon or injuries to the perinæum, most frequently falls astride of a bar, a fence, or some resistant body; it may occur from fracture of the pelvis or from laceration of the urethra; it sometimes follows injuries or twists of the penis received during coitus,

or the so-called "fracture of the penis"—a subcutaneous rupture of the erectile tissue from violence while the organ is erect; occasionally it results from the reprehensible practice of suddenly and violently straightening the penis during chordee—"breaking a chordee." Instrumentation in the normal urethra, if rough, clumsy, or unusually prolonged, as in some cases of litholapaxy, may be followed by contraction of the canal. Foreign bodies of all sorts arrested in the urethra, and ulceration from any cause, as chancre or chancroid, are competent causes of stricture, among which must also be included some of the methods of treating previous contractions, as by incisions, excision, cauterization, electrolysis, etc. The widespread popular belief that injections are frequently the cause of stricture is unfounded. If they are very irritant, or so strong as to act as cauterants, they may be; but as ordinarily used, by lessening the intensity of the inflammation and coating and protecting the urethra, they serve to diminish the exfoliation of epithelium, and thus lessen the leakage of urine, which, as we have seen, is the chief cause of organic stricture.

Prolonged erection, excessive coition, and masturbation have been invoked as competent causes of stricture, more especially by those ardent believers in stricture of large caliber who find them in nearly every urethra, and often in the absence of what Guyon calls a "urethral history," which he considers an essential in the diagnosis of stricture—i. e., the history of gonorrhœa or of some one of the sources of irritation above enumerated. While the possibility of stricture from such a cause as masturbation can scarcely be denied on theoretical grounds, its occurrence is, as a matter of fact, of the greatest rarity. This is shown by the comparative infrequency of strictures among adult males of any community as compared with the number who have at some period of their lives been addicted to the habit of masturbation, and still more forcibly by the history of persons in prisons, asylums, and hospitals for the insane, who have been known to practice the habit to excess over long periods. Some years ago, while acting as medical officer to the Eastern Penitentiary, a prison containing about 1,000 convicts, and conducted on the principle of separate confinement, I began some observations upon the urethræ of those prisoners who were known to be persistent masturbators. I abandoned the investigation on account of the impossibility of eliminating other causes of disease, particularly gonorrhœa; but it was perfectly clear that among that class of prisoners there was not an unusual number of coarctations; and I do not think masturbation a sufficiently active or efficient cause for their frequent production. If it were a cause, the effects would surely in a certain proportion of cases be more serious and more noticeable; if it were capable in nearly every case, as has been claimed (Gross, *Medical and Surgical Reporter*, May 5, 1877), of produc-

ing one stricture of large caliber, it would sometimes be followed by several strictures of smaller caliber. The institution alluded to is one which affords exceptional advantages for the study and observation of onanism and its effects, and the subject was one in which I was specially interested; but I do not remember, during my experience of three years, ever to have seen in a confirmed masturbator retention or incontinence of urine, frequent or difficult micturition, or any of the more marked symptoms which would usually accompany stricture of the urethra. Neither have I learned that those physicians who have charge of the insane, and who see large numbers of onanists, have ever made similar observations.

If stricture is no more common in such patients than among their associates, it may safely be assumed that, at least as ordinarily practiced, masturbation can only be productive of organic stricture with such rarity as to make it scarcely worth considering as an etiological factor. The dictum of Sir James Paget may still be said to

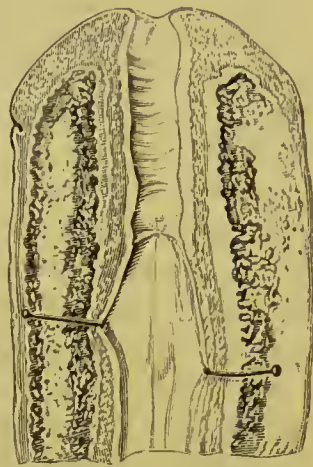


FIG. 1.—(Voillemier.)

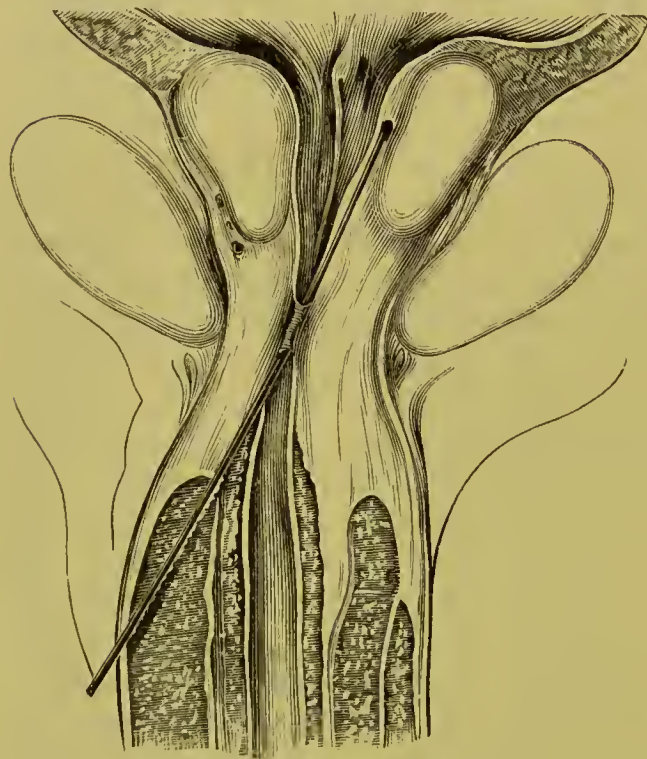


FIG. 2.—(Dittel.)

express the view of the profession, namely, that "masturbation does neither more nor less harm than sexual intercourse, practiced with the same frequency, in the same conditions of general health, age, and circumstances" (Clinical Lectures and Essays).

Character of Stricture.

—The pathological condition varies from an induration and thickening of the mucous membrane with connective-tissue proliferation occurring in its depth to the formation of a dense mass of cicatricial tissue occupying the submucous region and extending into

the meshes of the corpus spongiosum. The strictured portion of the urethra varies greatly in extent from a mere cordlike band, the so-called *linear*

stricture (Fig. 1), to one slightly broader (*annular stricture*) (Fig. 2), and from that to a contraction which may involve as much as two or three inches of the canal, converting it into a devious, irregular channel. This has been called the *tortuous stricture* (Fig. 3). Many classifications have been adopted, but this answers very well for practical purposes. They have also been divided (Keyes) into—1, soft or recent, including those in which the lesions are superficial and involve chiefly the mucous membrane—this subdivision embraces the strictures of large caliber and the cases of chronic urethritis resembling stricture or constituting its first stage; 2, cicatricial, usually traumatic; and, 3, nodular, always gonorrhœal, and characterized by a lumpy, irregular, ill-defined mass of new fibrous tissue, often cartilaginous in consistence. A peculiar form of contraction of the meatus, of which I have seen several examples, consists in a diffuse induration of the mucous membrane, the hardness extending outward on the glans and for some distance inward. The indurated tissue was searlike in appearance and semi-cartilaginous in consistency. In one of my cases the condition was associated with a tightly adherent prepuce in a man past middle age. In two cases reported by Greig Smith (Bristol Med.-Chir. Jour., September, 1884, page 154) the same condition existed. It appears to be a form of scleroderma. Local treatment was of little avail, but in my cases there was much spontaneous improvement after a considerable lapse of time.

Strictures are further divided into *irritable*, when they are readily inflamed and bleed easily upon the touch of an instrument, and *resilient*, when they are elastic and contractile, returning with great rapidity to their former size after being dilated. These conditions depend upon the relative vascularity and density of the cicatricial tissue constituting the stricture.

They are also divided into those of *large caliber* and those of *small caliber*.

For many years the greatest differences of opinion in regard to urethral stricture have centered upon the existence or non-existence, the pathological importance and the treatment, of strictures of large caliber. They have been asserted, on the one hand, to be, by reason of the frequency of



FIG. 3.—(Thompson.)

their occurrence and of the failure to recognize them, the most important of all strictures; while, on the other hand, a recent excellent little manual (Culver and Hayden, page 88) gives them no place in the classification of strictures, but includes the conditions heretofore described as strictures of large caliber under the caption "Chronic Anterior Urethritis."

That every urethral coarctation following on urethritis must at some time have been a stricture of large caliber is self-evident, but just when such a stricture becomes an active pathological factor, and is able to give rise to symptoms, is an unsettled point. Indeed, it is not probable that it ever can be definitely determined in a mathematical sense. The idea that any particular fixed caliber represents the normal condition of the urethra has long been abandoned, the observed variations of that canal being such that no special dimensions can be assigned to it as representing the precise dividing line between health and disease. The old method of regarding the size of the meatus as an indication of the normal caliber of the canal behind it, although it still has the weighty indorsement of Guyon, is also unquestionably fallacious, it having been conclusively shown that no more definite relation exists between them than between any other mucous canal and its corresponding outlet—the mouth and the œsophagus, for instance, or the anus and the sigmoid flexure. That there is a certain correspondence between the size of the urethra and that of the flaccid penis is true, the caliber of the one increasing with the circumference of the other, but that this ratio is present in any absolutely unvarying manner has not yet been demonstrated. At the most, the size of the penis may be said to furnish a general indication of the urethral dimensions, but one which is approximate merely. On the other hand, it has been shown that there are usually certain normal variations even in the spongy portion, and that it is impossible with any of the means at our command to distinguish between these natural irregularities and coarctations of equal caliber due to incipient stricture. I have myself always emphasized the occasional pathological importance of even a moderate infringement upon the caliber of the urethra (*International Encyclopædia of Surgery*, vol. ii, page 353), and have elsewhere summarized (*Annales des maladies des org. gen.-urin.*, Paris, November, 1888) the theoretical arguments in favor of regarding the group of symptoms which includes gleet, frequent urination, dribbling after micturition, and lumbar and hypogastric pain, as usually indicative of some degree of urethral coarctation. Those arguments were in the main as follows:

Habit is a powerful agent in facilitating and controlling the functions of animal life. Illustrations of this fact in other systems than the genito-urinary are frequent and familiar. The evacuation of the bowels at certain hours of the day, and the difficulties resulting from inattention to their requirements; the easy and unnoticed digestion of food taken at

proper intervals, and the anorexia and dyspepsia following irregularity in this respect; the imperceptible and uniform action of the heart under ordinary circumstances; its tumultuous and uneven palpitation when its work is suddenly increased; the many apparently trivial agencies which are notably sufficient to interfere with the mental processes when accustomed routine is broken into—all these are a few of the unlimited examples that might be adduced to show the force of habit in influencing the mode of performance of such functions.

To take up the case in question, it is safe to say that, in a healthy male adult, a certain equilibrium has been established and maintained between the usual efforts and powers of the bladder as an expulsive organ, and a certain average amount of resistance which must be overcome before it can empty itself. At the age of twenty-one years this adjustment of force depends upon a large number of previous distinct acts of micturition—about thirty thousand, if an average of four daily be taken. This balance between the force of expulsion and its work can not with impunity be disturbed, and even a slight interference with the caliber of the urethra may exceptionally tend to produce such disturbance.

Apart from the proclivity to muscular spasm in the neighborhood of and behind every stricture, this interference with the action of the bladder arises from the encroachment of the new deposit upon the urethral caliber. It is a law of hydrostatics that a degree of friction proportionate to the amount and velocity of the current and the size of the tube takes place between the walls of the latter and the liquid; if the tube be narrowed at any one place, the friction is increased at that point, and, to avoid a diminution in velocity, the propulsive force behind the liquid must also be correspondingly increased. The pain excited by the very simple experiment of moderately compressing the urethra during micturition will serve to illustrate the bearing of this fact, as does also the exceedingly slight amount of prostatic enlargement which often suffices to bring on vesical troubles.

Still another point may be mentioned. The act of micturition is one requiring for its perfectly normal performance, first, relaxation of certain muscles to secure patency of the urinary channel and, next, the thorough and complete contraction of those muscles to produce entire evacuation of the contents of the passage, which would otherwise leave it *guttatim*. The latter portion of this act is accomplished by the contraction of the circular fibers which surround the urethra, and which, during the intervals of urination in a healthy condition, serve to bring and retain its walls in close apposition. The submucous deposit, which increases the friction of the stream of urine at any point, also interferes with the accurate closure of the canal by those muscles whose action is impeded, and whose structure itself is in part often invaded, and, as a consequence, we

have an imperfect emptying of the urethra at the end of urination. Finally, if, in addition, we recall the intimate nervous connection of the urethra with all the viscera of the abdomen and pelvis, and with the walls of those cavities, we are in a position to sum up the mutual relation of the pathological and subjective phenomena as follows:

The increased friction and resistance resulting from even a slight fibrous periurethral deposit may disturb the normal relations of the bladder, and, by rendering it irritable, bring on one of the common symptoms of stricture, frequent micturition. The imperfect closure of the tube, the muscular action of which at the point of deposit is materially interfered with, causes the equally imperfect expulsion of the last drops of urine, and produces another equally characteristic symptom, dribbling at the end of micturition. The retention and decomposition of these last drops, together with the abnormal friction between the stream of urine and the urethral walls, give rise to a subacute inflammation of the mucous membrane, accompanied with a catarrhal or muco-purulent discharge, constituting the condition of gleet; by reflex irritation transmitted from the area of inflammation, pains in remote organs and situations are developed, notably in the lumbar and hypogastric regions.

This relation of causes and effects has been in the main accepted as correct by the profession for many years. Probably no one denies that in certain strictures in which the urethral caliber is markedly diminished the connection between the pathological changes and the observed indications is about as has been stated. The differences of opinion which now exist are chiefly as to the amount of urethral contraction which is sufficient to produce noticeable effects, and here the argument must rest upon clinical observations supported by the results of autopsies.

Those surgeons who follow the teachings of Dr. Otis, of New York, whose valuable work has added greatly to our knowledge of the subject in question, accept his scale of relation of the caliber of the urethra to the circumference of the flaccid penis, any interference with which they regard as evidence of the existence of stricture. The figures which Dr. Otis gives, while they doubtless represent accurately the *distensibility* of the male urethra, do not by any means represent what can fairly be called its normal caliber, and fail altogether to recognize the fact that there are points of physiological narrowing, notably along the course of the pendulous urethra, where some of his disciples find the greatest number of contractions. Sir Everard Home, Du Camp, Reybard, and others long ago demonstrated the variations in size and dilatability of the different portions of the urethra; and Civiale observed that in the middle of the spongy urethra there is a notable diminution of elasticity. Weir and Sands, of New York, confirmed by casts of the urethra these older observations, and there can now be no doubt of the existence

of such physiological points of contraction, or of diminished distensibility.

Delpet has recently (*Ann. des mal. des org. gen.-urin.*, March, 1892, page 196) made a series of elaborate experiments to determine this and other points in the anatomy of the normal urethra. He found almost invariably a narrowing in the penile urethra at a point three to ten centimetres (one to three inches) from the meatus, at which region tears of the urethral wall from the passage of large instruments occurred with the greatest frequency. The next least dilatable and least resistant region was in the vicinity of the "prepubic angle." In but one instance was there any laceration in the bulbous urethra.

Guyon has, perhaps better than any one else, emphasized (*Leçons cliniques*, Paris, 1881, page 680) the distinction between the true caliber of the urethra and its distensibility. He believes that the normal caliber can be determined only approximatively, as the urethra is a canal only when traversed by a liquid or an instrument, and in the intervals lies collapsed in longitudinal folds and with its walls in contact. The true caliber is therefore that which separates the walls without stretching them. Sappey has endeavored to ascertain this, and asserts that, exclusive of the meatus externus, the average normal urethral circumference varies at parts from fifteen to eighteen millimetres, and that therefore a sound of No. 15 caliber (French) can be passed without calling into play the dilatability of the canal. Guyon states that his own clinical observations agree with these experimental results, but he also instituted a series of experiments by passing in thirty-seven instances on the cadaver catheters, varying from about No. 31 to No. 34 (French). In thirty instances lacerations were produced; in half of them, in the anterior or middle portion of the penile urethra; they were almost exclusively on its inferior wall. He, as well as the other authorities mentioned, recognize the fact that the urethra is of varying caliber and has points of normal constriction.

Otis, however, in effect assumes that the urethra should be a tube of uniform caliber, at least anterior to the triangular ligament. The instrument which he has devised, the urethrometer, when used under the guidance of Otis's table, will detect apparent strictures in the majority of normal urethras, and is to-day only employed by practical surgeons in exceptional cases. A very ingenious instrument, the "urethrograph," has also been invented, and is said to be capable of giving an exact drawing of all the irregularities of the urethra; but, as Keyes says, while it seems an ideal mechanical device, its creation is to be deplored, since it "will tend to increase the already too great cutting of that patient canal, the urethra." Dr. Otis's views and teaching both as to diagnosis and treatment have been of great value as showing the distensibility of the

normal urethra, as thus paving the way for the introduction of the large instruments employed in litholapaxy, as bringing out the full pathological value of true strictures, however slight, and in other particulars adding exactness to urethral surgery. It is not against their use but against their abuse that I desire to protest, and I shall have occasion to recur to the subject when considering the treatment of stricture (see page 310). We may admit at present for purposes of classification, that, exclusive of cases that are best described as examples of chronic urethritis, there are others in which the superficial inflammation has largely disappeared, and in which the periurethral or submucous deposit has begun to contract and to diminish the lumen of the canal, such contraction still admitting fairly good-sized instruments with ease. Such cases are entitled to the designation of stricture of large caliber, which appears to me accurately to describe them.

I have found it convenient, both in teaching and in practice, to make an arbitrary division of all organic strictures into those which will only admit instruments of less than fifteen millimetres in circumference and those which will easily permit larger instruments to pass, calling the former *strictures of small caliber* and limiting to the latter the term *strictures of large caliber*.

Location of Stricture.—The situation of stricture varies, but there can be no doubt that the great majority are to be found in the bulbo-membranous region, which includes a space from about one inch in front of the anterior layer of the triangular ligament to the prostato-membranous junction. The next most frequent seat is in the first two and a half inches of the urethra. The frequency of stricture in these regions is due to the fact that they are exceptionally vascular, and that chronic urethritis is especially apt to become localized at those points. Gravitation in both regions favors chronic congestion and may possibly of itself explain the clinical fact. The smallest number are found in the middle of the spongy urethra. These remarks apply to the form of stricture produced by urethritis. Traumatic stricture usually affects the membranous urethra.

The chief differences of opinion in regard to location will be found, when analyzed, to originate in an essential difference in the manner of approaching the subject. Those surgeons who very properly demand evidence of some organic change before admitting the existence of stricture, and base their views on the examination of existing specimens in museums, differ greatly from those who depend upon the urethrometer, and who believe in Otis's teaching of an almost unvarying relation between the caliber of the urethra and the size of the penis.

Thus we find that, while in 320 specimens examined by Sir Henry Thompson he found the stricture in 216, or sixty-seven per cent, in the

bulbo-membranous region in 54, or seventeen per cent, within two and a half inches of the meatus, and in 51, or only sixteen per cent, in the intermediate spongy portion; Otis describes 258 strictures under his care as having been situated—115 in the first inch and a quarter, 129 between one and a quarter and five and a half inches from the meatus, and only 14 between five and a quarter and seven and a quarter—i. e., in the region of the bulb and the membranous urethra. It is scarcely to be doubted that many of these “strictures” were points of physiological narrowing.

Stricture of the prostatic region is practically unknown.

Guyon * divides the urethra into six regions : 1. The navicular region, which corresponds to that part of the urethra surrounded by the glans penis, and extending from the meatus externus to the corona glandis. 2. The penile region proper, reaching from the termination of the navicular region to the entrance of the urethra into the scrotum. 3. The scrotal region, including, of course, all that part of the urethra contained within the limits of the scrotum. 4. The perineo-bulbar region, which extends from the posterior limit of the scrotal sac to the passage of the urethra under the pubic arch. 5. The membranous region. 6. The prostatic region. He finds gonorrhœal strictures most frequent and narrowest at the bulb. He adds that there are often, in addition, one just behind the navicular fossa and one at the peno-scrotal junction. In the navicular region cicatricial strictures from local and minor injuries are most common, as they are in the perineo-bulbar region from deep contusions and lacerations. In the scrotal and penile regions strictures are least frequently found.

Traumatic strictures are nearly always single, and may be due to various causes. They occur in the mid-penile portions of the urethra after rupture of a chordee; at the root of the penis when caused by “false movements” in coition; at the perineal or perineo-bulbar portions of the urethra when following falls on the perinæum; in the membranous portion after pelvic fracture, which Guyon thinks is the only traumatism that causes stricture in that region; at the meatus or fossa navicularis when the stricture is of chancreous origin or is due to the irritation of foreign bodies.

Changes in the Urethra.—The urethra behind a stricture undergoes certain progressive changes. It at first becomes dilated and thinned; the walls atrophy; it is deeply congested, the change of color in the surface at this point being often the most conspicuous feature in a strictured urethra laid open after death. As the stricture grows smaller the changes

* *Lçons cliniques*. See an excellent abstract by Dr. William Mastin (*The Annals of Surgery*, August, 1882).

in the mucous membrane become more marked. The increasing pressure causes a corresponding increase in the pouching or dilatation, the retained urine decomposing sets up a superficial inflammation, erosion of the surface occurs, it is denuded of its epithelial layer, actual ulceration follows, and, as the loss of substance becomes greater, larger and larger quantities of urine escape into the spongy tissue, especially toward the floor of the canal, and abscesses followed by urinary fistula result. Delpet (*op. cit.*) has called attention to the fact that the mucous membrane of the urethra is in immediate contact with the erectile tissue of the spongy body, and that the lacunæ of Morgagni penetrate into the meshes of that structure. Stilling (*Archiv für klin. Chirurgie*, vol. xv, page 22) has also noted the intimate relation between the muscle and connective-tissue fibrils of the corpus spongiosum and the urethral mucous membrane, and thinks it explains many phenomena otherwise inexplicable, as the occurrence of spasm in the spongy urethra, the dribbling of urine in cases with exceedingly slight obstruction, etc. When the urine first reaches the surface of the body by the newly formed fistula the latter has soft, yielding walls, but these gradually become dense and indurated, undergoing the same pathological changes as did the original strictured region. Bryson has well described (*op. cit.*, page 285) the subsequent changes: At first, when the fistula has formed and has soft walls, there is no great obstruction offered by it, and all the urine passes through by the new channel; but, however wide the fistulous opening may be, some urine comes in contact with the posterior edge of the stricture, perhaps remains constantly in contact with it, and thus there is the necessary condition for a continuation of the periurethral contraction of the stricture band, and especially of its posterior edge. This answers to this stimulation just as the stricture did originally, and tightly seals the urethral outlet of the pouch, forcing the urine to pass by the new way. It takes time for hard walls to form about the fistula, and more time for them to contract to such a degree as to offer great resistance to the urine. When they do, we have what seems a battle between the urethral narrowing and the obstructive efforts on the part of the fistulous opening, and the periurethral bands at the site of stricture hold their own even when they are only a line or two in breadth, for they are often seen to keep the urethra tightly closed while forcing the formation of one, two, several new fistulous outlets, which latter have at first soft and yielding walls, which offer a minimum of resistance.

There is sometimes seen in front of the stricture under these circumstances a second pouch or infundibulum (*Dict. des sci. med.*, article Urethra), which is, however, of a paler color and does not present the same indications of chronic inflammation. It is due to the atrophy and disappearance of the anterior portion of the coarctation, which, not being

exposed to the continual irritation of the urine, has undergone retrograde metamorphosis and absorption. All urethræ do not undergo this precise series of changes in the presence of strictures, nor do the latter always contract with the same degree of rapidity. The differences depend on factors which can not be accurately determined or even estimated: the more or less irritant qualities of the urine, the amount of vital resistance of the tissue, the degree of compensatory hypertrophy of the bladder, etc. Occasionally a stricture may remain stationary for long periods, but as a rule the tendency is toward continuous contraction.

The *opening* of a stricture is only exceptionally found in the center of the urethra; much more commonly it is near the roof, as the bulk of the stricture formation is more apt to take place on the floor of the canal, and by encroaching upon its caliber from that direction to force the aperture out of its normal position and in an upward direction. It may, however, be found at any point of the circumference of the urethra.

The *consistence* of strictures varies with their age and with the greater or less amount of fibrous and elastic tissue which they contain. Their distensibility varies inversely with the consistence, as does usually their elasticity. The latter quality is undesirable from a therapeutic standpoint, as when elastic tissue is in excess we have the so-called "resilient" stricture, which may permit readily of the passage of instruments, but will return almost instantly to its original caliber.

Section of a stricture of the annular or tortuous variety shows a more or less imperfect ring of new inflammatory tissue whose limits taper down gradually; this tissue is hard, yellowish-white near the lumen and darker on the outside, where reddish islets are seen, the result of hæmorrhagic infarcts, which form a focus for new inflammatory changes. The surrounding tissues, as the mucous membrane itself, the spongy, and even the cavernous bodies, may be involved. These changes are always greater on the floor. In the latter situation, according to Brissand and Segond, is found a hard, dense, fibrous, triangular mass, with its summit running up to the mucous membrane and its wide base resting on the albugineous coat of the spongy body, occupying on an average about one fifth of the circumference of the urethra. On the roof is a narrower strip of the spongy body changed to fibrillar elastic elements. This does not involve the whole of the thickness of the spongy body. The two lateral walls are unchanged, their tissue gradually running into the elastic elements above and the fibrous stratum below.

Although Oberländer has shown that the inflammatory process practically begins in the glandular recesses, and these are most abundant on the roof, yet the floor presents the greatest changes, from the fact that the gonorrhœal process is always more active there.

Complete obliteration of the urethra is extremely rare, and it is doubt-

ful if it ever happens except in the traumatic forms of stricture following extensive laceration or complete separation of the urethra.

Tadriatte (*Dict. des sciences méd.*) has collected nineteen cases of complete obliteration; fifteen of these were at the bulb, one at the suspensory ligament, two in the penile portion, and one three inches behind the meatus.

The last four cases followed bullet-wounds. The obliteration was usually about one to two centimetres in length, with fistulæ behind; in one case only, that of Peso, a fistulous tract around the cicatricial tissue, maintained a passage for the urine; it was probably the result of a false passage.

Symptoms of Stricture.—The phenomena produced by stricture vary, of course, with the degree and character of the coarctation. They may be described, however, most conveniently by dividing them into, first, subjective symptoms—those recognizable by the patient; and, second, objective symptoms—those elicited by surgical exploration.

The **subjective symptoms** may be considered in the order of their frequency, certain of these being common to all strictures, others usually confined to very narrow or tight stricture.

a. Inquiry should be made for the so-called “urethral history” (Guyon). This should disclose a precedent urethritis, usually of a date at least one or two years earlier, often having been of long duration; or a trauma to the urethra, perinæum, or pelvis; or a urethral chancre; or some of the causes mentioned on page 267, as competent to produce a stricture.

b. Alterations in Micturition.—1. *Frequency.*—This arises first from the change in relation between the expulsive force required of the bladder and the accustomed demands upon it; then from extension of inflammation backward by continuity until the vesical neck is involved; often from the production of a genuine cystitis; later from atony with retention, there being often an unsuspected amount of residual urine present in cases of stricture (Fenwick, *Journal of Cutaneous and Genito-urinary Diseases*, November, 1888, page 414). In these cases the frequency is worse by day, as in stone; not by night, as in prostatic disease.

2. *Change in the Character of the Stream*, which may be double, flat, gimlet-shaped, or spray-like, and in tight strictures becomes much reduced in size. This symptom is of but little value, as both the shape and size of the stream depend more on the shape and size of the meatus than upon any condition posterior to it. If the meatus is of good caliber, urethral narrowing may remain unnoticed for some time, as a compensatory hypertrophy of the detrusor urinæ occurs which overcomes the obstruction.

3. *Diminution of Expulsive Power.*—This is a late symptom, and

is only developed when vesical atony has succeeded to the hypertrophy just described.

4. *Dribbling after Urination* depends upon the retention behind the stricture of some drops of urine, which escape by gravity after the act of micturition is complete. It is not infrequently a very early symptom, dependent on irregular action of the circular muscle fibers of the urethra. The dribbling, which is called the "incontinence of retention," the overflow from a distended bladder, is a very late symptom, following retention and usually associated with a high degree of atony. The incontinence of stricture is to be diagnosticated from the incontinence of prostatic hypertrophy by the fact that it is at first worse in the daytime, and only becomes nocturnal later. The reverse is the case in prostatic incontinence. The mechanism of incontinence of urethral origin is simple. The dilatation of the urethra behind the stricture having extended to the neck of the bladder, the urinary reservoir becomes in shape a funnel, the bladder representing the base, the neck situated at the point of stricture. The patient being in the erect position, the weight of the column of urine comes directly on the stricture, which permits it to filter through drop by drop. In dorsal decubitus, on the other hand, the bladder fills up and retains its contents until the changes in it and in the urethra are very far advanced. In the prostatic patient it is possible that the physiological congestion of the lumbar cord produced by the recumbent posture makes urination more frequent at night and during the early morning hours. It lessens as the day goes on, and it is only later when the bladder becomes confirmed in irritability that diurnal frequency follows.

5. *Ardor Urinæ* is extremely variable, but is not apt to be marked unless there is a considerable degree of prostatitis present.

6. *Retention of Urine* may occur early and suddenly from an acute increase of the congestion of the mucous membrane of the strictured region, or it may be a late symptom and dependent on the great obstruction offered by the stricture. In either case it is apt to be precipitated by fatigue or cold, or by alcoholic or sexual excess.

7. *Vesical Tenesmus* is usually constant during the entire act of micturition; that of prostatic hypertrophy is most violent at the beginning, and grows less as the water begins to flow; that of cystitis is most severe at the end of the act.

c. *Urethral Discharge*.—Opinions vary as to the constancy of this symptom in its relation to stricture. On the one hand, they are said to have an invariable and reciprocal relation to each other (gleet being the "signal" which stricture throws out in evidence of its presence); on the other, it is said (*Dict. des sciences méd.*) to have occurred only four times in sixty-one cases of stricture (Janin). According to my own experience, about fifty per cent of strictures are accompanied by a gleet discharge.

from the meatus, and a large majority of the other fifty per cent show mucous and epithelial shreds and pus-corpuscles in the urine. I believe with Desnos (*op. cit.*), however, that many of Otis's cases of "gleet with stricture of large caliber" are merely cases of chronic urethritis.

d. Interference with Coition.—The physiological congestion is increased; after the orgasm, semen is retained behind the stricture, and great pain may be occasioned by the distention of the urethra at that point; the semen dribbles away slowly for a long time after the subsidence of the erection; ejaculation, when it takes place at all, is often premature; erection is apt to be imperfect or to subside before the completion of the act.

e. Constitutional Symptoms.—These are late, and depend upon the vesical and renal changes with the concomitant alteration in the urine. They are therefore usually a combination of uræmie and sapræmic or septicæmie phenomena. There is a red, glazed tongue, with anorexia, dyspepsia, constipation, etc. The dryness of the tongue extends to the walls of the pharynx, making deglutition painful—"buccal dysphagia" of Guyon. An irregular febrile movement supervenes; the face becomes pinched and yellow, the eyes sunken, the general strength fails, and the patient, after rapid emaciation and profound prostration, dies comatose.

Objective Symptoms of Stricture.—In describing the methods to be employed in the detection of urethral stricture it will be necessary to add somewhat to the statements already made in reference to the anatomy and physiology of the canal. Guyon (Mastin, *loc supra cit.*) believes that it would be of advantage so to divide the urethra that the location of a contraction at any one point of the canal can be designated at once in an easily expressed and clearly comprehensible manner, or, in a word, that the urethra be examined in its entire length by regions and not by centimetres. He has therefore divided it into the six regions already described. These regional divisions, he declares, are amply justified by clinical experience and certain distinguishing features, since in connection with the navicular portion is to be remembered the care to be exercised in the employment of fine instruments, presenting them to the inferior and not to the superior wall, as is the rule in the other regions, the arresting of extraneous bodies, and the frequency of cicatricial strictures. The penile is the portion which is the most movable, the most superficial, and the least fixed; contractions which are observed in it present the clearest pathological characters; fistulæ occurring here require absolutely special operative measures for their closure. In the scrotal portion, which is deeper and more fixed, stricture is comparatively rare; foreign bodies are seldom arrested; and when it becomes necessary to open it, for instance during the swelling and thickening attending abscesses or urinary infiltration, when it is difficult to trace by the finger an

instrument introduced into the canal, the median line is the most convenient guide. The perineo-bulbar portion is really fixed and deep; it is the seat of election for blenorrhagic contractions, and here, too, traumatic strictures from deep contusions and lacerations of the urethra are more frequently encountered; again, it is toward this region that the bistoury must be directed in deep urinary infiltration and in practicing external urethrotomy without a guide (perineal section) when it should be opened in the median line exclusively.

Guyon further continues his admirable description by examining the so-called urethral curves. The superior wall has alone anything like a fixed curve or approaches the arc of a circle. The inferior wall, on the contrary, is only a broken line. This inferior surface is composed of three portions, of which the incurvations are unlike, and which are separated by two bends or angles, the form and situation of which are equally far from being fixed. The first portion of this broken curve is formed by that part of the prostate just above the openings of the ejaculatory ducts; the second is represented by the *sus-montanale* portion of the prostate, more or less developed, and by the entire membranous division, and varies greatly as to length and form; and the remainder is formed by the bulbar portion, which presents more uniformity in its disposition; hence, at the union of these three curved lines are found two species of bends or dilatations, which are the cause of the change of direction of the contiguous parts. Guyon directs attention to the fact that the inferior wall is extensible, soft, and depressible, and is subject to variations of both form and length; hence, the important point to be borne in mind by the surgeon is, that in catheterism he should either follow exactly in the curve of the superior wall, or modify the direction of the urethra; and to determine the adaptability of the canal to instruments, anatomy must be depended upon to indicate to us the normal direction of the urethra and the limit of modification which it will bear without sustaining a lesion; and here it is to be especially remembered that the first part of the urethral curve—that extending from the suspensory ligament to the entrance into the membranous division, is, above all the rest, susceptible of modification and change of direction. The urethra has no lateral flexions, presenting neither bends nor flexuosities, but is exactly parallel with the median line. Nothing, however, is easier than to produce them in the entire spongy region, particularly in the bulbar portion.

It should never be forgotten, in making examinations for stricture, or indeed in any urethral instrumentation, that the elasticity or extensibility of the urethra resides for the most part in the spongy portion, as is clearly demonstrated by erection; and this elasticity belongs in the greatest degree to the inferior wall, which permits of easy distention or elongation, and changes its dimensions and form with notable facility;

while the superior wall yields with much more reluctance, and offers a certain resistance to all agents tending to depress or elongate it. This difference increases with age, and obtains especially in senile urethræ.

The surgical interest in all this, in its relation to the treatment of stricture, is evident, since the extensibility of the inferior wall is brought into play even by a moderate force, and the surgeon can not count on its resistance. It glides before an instrument, and can not serve to guide it; it can not be incised with any accuracy or precision; it lacerates or ruptures when surprised by distention, and it yields rapidly and easily to a mechanical pressure testing its extensibility. It should be noted, too, that this elongation of the canal is chiefly at the expense of the anterior urethra. Again, the spongy portion does not yield equally in all its parts, since it has been shown that of the different regions the perineo-bulbar is the most distensible. The inferior wall of the urethra can then be considered as normally longer than the superior surface. The term "surgical wall" proposed for the upper wall by Gnyon would seem to be merited because it offers the shortest route to the bladder; it is the most regular and constant as to form and direction; presents the smoothest and firmest surface; is the less capable of gliding before an instrument or being modified by mechanical pressure; offers the greatest assistance to rupture and penetration; is less intimately connected with important structures, and is the least vascular of the two walls. As to the caliber and distensibility of the urethra enough has already been said; but it should not be forgotten that there are two relatively constricted points, the internal and external meatus, and three dilatations, the fossa navicularis, the bulbar *cul-de-sac*, and the prostatic depression, the last two dilatations presenting numerous individual varieties; and in this connection it is important to remark that all three of these dilatations are excavated at the expense of the inferior wall of the canal. The urethral curve only remaining regular in the superior wall, it results that the more pronounced the curve the more accentuated are the bulbar and prostatic depressions; and as a certain degree of lengthening of the urethra always corresponds to the greatest curve—since these are both produced by bulbar and prostatic augmentation of volume—one can reasonably conclude that urethræ of the greatest curves present at the same time the greatest length. With a knowledge of these facts the instrumental exploration of the urethra becomes a matter of much accuracy and precision.

The most valuable urethral instruments for the purpose of diagnosis are the so-called *bougies à boule* (Fig. 4). They may be made of metal, with slender stems, having small expanded ends or handles, upon which the number of the instruments may be marked; this should represent in millimetres the circumference of the shoulder of the bulb. More satis-

factory instruments are, in my opinion, the flexible gum *bougies à boule*. The shoulder of the acorn-shaped bulb should join the shaft at almost a right angle, and not with the obtuse angle often found in improperly



FIG. 4.

shaped instruments. The size selected for exploration should be determined approximately in the manner already mentioned, by noting the circumference of the flaccid penis. Otis's scale is as follows:

Circumference of penis 3 inches; caliber of urethra 30 inches.

"	"	3 $\frac{1}{4}$	"	"	"	32	"
"	"	3 $\frac{1}{2}$	"	"	"	34	"
"	"	3 $\frac{3}{4}$	"	"	"	36	"
"	"	4	"	"	"	38	"
"	"	4 $\frac{1}{4}$	"	"	"	40	"

The scale which I have adopted for use, and which differs from that published by Dr. Otis in giving a lower grade of numbers, is as follows:

A penis three inches in circumference at the middle of the spongy portion indicates a urethra which should normally admit an instrument of about twenty-six to twenty-eight millimetres in size; when it is three and a quarter inches, the urethra should have a caliber of from twenty-eight to thirty millimetres; three and a half inches, thirty-two to thirty-four millimetres; four inches, thirty-four to thirty-six millimetres, beyond which size it is seldom necessary to go.

If the meatus be too small to admit of the introduction of a bulbous bougie of the required size, it should be enlarged. The penis should then be grasped just behind the corona and held gently between the thumb and finger of the left hand, the foreskin, if redundant, having been retracted. The dorsum of the penis should face the abdominal wall. The bougie, well oiled, should then be passed gently into the bladder. If arrested, the point on the shaft corresponding to the meatus should be marked, the distance from that to the bulb representing the position of the anterior face of the stricture; or the region in which it occurs should be carefully noted. If that instrument, or a smaller size, passes through, it should then, after a moment's delay, be withdrawn, and if during its outward passage any contraction is found other than that at the triangular ligament, it is probably due to stricture; though spasm, which often relaxes after a few seconds, or shifts its position in the canal slightly, as measured from the meatus, may give rise to errors in diagnosis. It can not always with certainty be recognized. It is almost never found except at the membranous urethra. It occurs in many urinary diseases, and especially in cystitis and tuberculous of these organs, although the membranous portion is very rarely affected in tubercular

cases by the disease itself. It is occasionally seen in cases of atresia of the meatus, or of phimosis, and in spinal cases, or in neuropathic and impressionable patients.

It should be remembered that gonorrhœal cases almost invariably give some point of induration or roughening at least of the urethra just anterior to the bulb. When this region is passed, if stricture exists there, the *bougie à boule* is released suddenly; spasm will often still hold the instrument firmly; on returning there is no resistance at this point in spasm, while in stricture there is the same obstruction and the same sudden release at the anterior end of the obstruction.

Pain as a diagnostic symptom is unreliable, but is usually greater in spasm. Metallic instruments used with care almost always pass a spasm. Uncomplicated stricture may be difficult to distinguish from stricture with spasm—i. e., stricture of the anterior portion with symptomatic spasm of the membranous portion.

By the smaller scale I have adopted the probability of mistaking physiological narrowing for stricture is greatly diminished; and I believe that cases which present definite symptoms, such as gleet discharge, frequent urination, dribbling at the end of micturition, etc., and in which such an examination discloses a distinct contraction, may with propriety be considered as cases of organic stricture. This is not unduly conservative, but represents fairly, I think, the views of the large majority of modern surgeons, and especially of those who have any claim from special study or experience to speak with authority on the subject of genito-urinary diseases. They will scarcely pass unchallenged by the practitioners who find, and cut, such a remarkable number of strictures in the penile urethra. It is, however, impossible, in my opinion, to read their statements as to the number of cases of this kind which they have cut and the number of strictures which they find in individual cases, and to recall at the same time the almost entire absence of post-mortem evidence in support of their views, without being led to question either their surgical judgment or their statistics, or both.

As to the diagnosis of stricture of large caliber, even the *bougie à boule* may be misleading, if used in the deep urethra, on account of the normal points of obstruction to both its introduction and withdrawal which are there met with, while the urethrometer is similarly misleading in the pendulous urethra, especially if its revelations are interpreted according to the unnecessarily large standard of Otis. In the latter region the normal variations account satisfactorily to my mind for that proportion of the statements of a few writers and would-be teachers on this subject, which may charitably be put down to self-deception. In the deep urethra it has been necessary for them to account for their frequent discovery of strictures, even in cases without an active etiological factor, by

attributing them to masturbation, sexual excess, etc. I have already expressed my opinion as to this point, and I may add that some years ago I endeavored, I believe successfully, to demonstrate that the "deep-seated stricture usually of large caliber found at the subpubic curvature and its vicinity," and described as "an essential lesion of masturbation" (Gross, *op. cit.*), was in reality the point of normal resistance to the withdrawal of bulbous bougies offered by the posterior layer of the triangular ligament.

The prostatic urethra being at once more movable and more dilatable than the membranous portion, the bulb slips smoothly along it until the point is reached at which this layer of fascia closely embraces the posterior part of the membranous urethra and the outer surface of the prostate. Here, for obvious reasons, it is arrested, and it is at this moment that the deceptive sensation which may be considered indicative of the existence of organic stricture is communicated to the hand. A series of observations and dissections upon the cadaver confirmed me in this view, which was originally purely theoretical, and, moreover, eliminated the possibility of the resistance being due to a spasm of the compressor urethræ muscle which surrounds the canal at this point, arrest of the instrument occurring just as invariably after death as before.

Having in a number of cases carefully brought the bulb closely up to the point of resistance, an assistant held it in position while I exposed it by a dissection of the deep urethra. I always found the shoulder of the bulb in the exact locality of the deep layer of the fascia, the edge of which would often be felt tense and cordlike over the upper wall of the urethra. A division on either side of its attachment to the ramus of the ischium, or to the pubes beneath the crura penis, would then cause an immediate disappearance of the resistance, and the bulb could be drawn outward smoothly and uninterruptedly. If the handle of the instrument were depressed during its withdrawal, the edge of the prostate became a cause of obstruction; and it may act thus to a greater or less degree in all cases.

The recognition of stricture of small caliber is a matter of no difficulty. In their presence it is well to use a medium-sized instrument, Nos. 16 to 18 (French) for purposes of exploration. When it is passed to the anterior surface of the stricture the region occupied by the latter may be easily noted, and its exact caliber determined by using successively smaller instruments. Multiple strictures may be recognized and measured in the same manner if they can be passed at all. The advantages of using a rather large instrument at first is that it eliminates the element of spasm of the membranous urethra, which will often, after a little gentle pressure, allow the blunt, rounded point of a medium-sized bougie to pass, although it would contract firmly and persistently before the point of a fine instrument. By using progressively smaller instruments also, the stricture can be more accurately measured as to both caliber and situation. Some-

times, when no *bougie à boule* will pass, a steel sound several sizes larger will do so with ease. The information it conveys is not so accurate, but is sufficiently so when the stricture is one of small caliber. The chief source of difficulty in diagnosis lies in the possibility of mistaking deep stricture for hypertrophy of the prostate, or *vice versa*. The distinction must be made by the history of the case, the age of the patient, the character of the symptoms, and the sensations communicated to the instrument in the urethra and to the finger in the rectum. It must be remembered that the urethra of prostatic disease is almost invariably elongated; that the shaft of the instrument will therefore enter it to an unusual depth, and that the handle must be more than ordinarily depressed before the beak reaches the bladder; that the patient is apt to be over fifty years of age, with the characteristic history of partial retention and nocturnal incontinence of urine; and that the obstruction will be found at a distance of more than six and a half inches from the meatus.

The points of normal narrowing of the urethra at the meatus, the middle of the spongy portion, and the membranous region will, of course, be borne in mind, and will not be mistaken for coarctations.

The presence, location, and caliber of a stricture having been determined, its dilatability is to be learned by the use of the conical steel sound, but it is usually well to make this investigation at a second visit.

Results of Stricture.—Unrelieved obstruction of the urethral canal continued for any length of time inevitably produces, in addition to the local conditions already described, a series of changes in the urinary tract posterior to the lesion.

Under long-continued and increasing pressure the urethra gradually enlarges, the mucous membrane becomes thinned and ponched, projecting in places between the bands of muscular fibers, forming diverticula analogous to those seen in the bladder. Sometimes, instead of the gradual escape of urine through minute openings with the formation of smaller abscesses and fistulæ, the urethra gives way more largely at a point behind the stricture, and *extravasation of urine* follows. The local symptoms of this condition are those produced by the retention of an irritant, and often a poisonous fluid within the tissues. The parts swell and become œdematous, the color of the skin changes to a dusky red or purple, emphysema from the gases of decomposition occurs, spots of gangrene develop, and extensive sloughing takes place. The general symptoms are those of profound sapræmia. There are great prostration, a dry, glazed tongue, a running pulse, frequent shallow respiration, wandering delirium, and finally, if the condition is unrelieved, death in coma. All these occur with greater intensity and rapidity if the bladder was already infected with the pyogenic and putrefactive microbes, and the urine was therefore fetid and purulent before extravasation occurred. This has been shown

experimentally by Menzel and others (quoted by Keyes, *op. cit.*, page 140), and is a common clinical observation.

The localizing symptoms—those which indicate the point at which the urethra has given way—depend upon the course taken by the urine. In all that part from the meatus to the scrotal curve, extravasation is accompanied by a swelling of the penis, greatest in the immediate neighborhood of the point of escape. In the region included between the attachment of the scrotum and the anterior part of the bulb, the course of extravasated urine is governed by the attachments of the deep layer of the superficial fascia, or the fascia of Colles. Extravasation of urine occurring through a solution of continuity in the bulbous region of the urethra will first follow the space inclosed by this fascia in front and below, and by the anterior layer of the triangular ligament posteriorly, and as it can not reach the ischio-rectal space on account of the attachment of the fascia to the base of the ligament, and can not reach the thighs on account of the insertion of the fascia into the ischio-pubic line, it is directed into the scrotal tissues, and thence up between the pubic spine and symphysis until it reaches the abdomen.

When it escapes from the membranous urethra, extravasated urine is confined to the region included between the layers of the triangular ligament, and only gains access to the other parts after suppuration and sloughing have given it an outlet, the consecutive symptoms then depending upon the portion of the aponeurotic wall which first gave way. If the opening is situated behind the posterior layer of the triangular ligament—i. e., in the prostatic urethra—the urine may either follow the course of the rectum, making its appearance in the anal perinæum, or, as it is separated from the pelvis only by the thin pelvic fascia, it may make its way through the latter near the pubo-prostatic ligament, where it is especially weak, and may spread rapidly through the subperitoneal connective tissue.

The *bladder* becomes affected as the evils wrought by stricture progress backward. Occasionally, when the obstruction occurs suddenly, the walls at once become thinned and atrophied by over-distention. As a rule, however, a compensatory hypertrophy takes place first; the muscles become thick and rigid; the capacity of the viscus diminishes; the muscular fibers stand out in bars or ridges, having between them lozenge-shaped spaces, over which the walls are greatly thinned. During the frequent and violent contractions of the organ the mucous membrane is driven outward between these muscular partitions, and the bladder finally becomes pouched at a number of places, the projecting sacculi (diverticula, tunicary herniæ) communicating with the interior by narrow mouths, and often containing gravel or calculi. Usually there is also a severe cystitis developed by infection through the urethra and adding greatly to

the severity of the symptoms. The sacculi occasionally, but rarely, rupture, in which case fatal collapse is apt to follow.

The *ureters* become dilated at about the same time, partly from the actual backward pressure of the column of urine in cases where there is a distended bladder, partly from the frequent compression of their vesical ends during the oft repeated acts of micturition. Their oblique course through the walls of the bladder render this compression very effective, and it has been shown (Morris) to be a competent cause for the production not only of ureteral dilatation, but also of hydronephrosis. Sooner or later, however, in addition to the distention of the ureters and kidneys and the mechanical interference thus occasioned with the secretion of urine, microbic infection occurs, and we have the renal alterations due to suppurative inflammation, a pyelonephritis first developing and then foci of suppuration at different points through the cortex and beneath the capsule, until finally the kidney may be converted into a large abscess cavity or into a series of pus-containing sacs, held together by the capsule and by inflammatory lymph, no trace of the secreting structure remaining. This condition has often been called "surgical kidney," but "unsurgical" kidney would be a more accurate term, as it never occurs in cases of stricture when competent advice is early sought and faithfully followed.

Among the possible results of stricture should be mentioned rectovesical fistulæ, vesical calculus, impotence, sterility, etc. Hunter McGuire has recorded (Medical Record, October, 1890) a number of cases in which paralysis, apoplexy, or some form of cerebral disease and spinal sclerosis followed long-standing stricture. He thinks that old strictures, by persistent irritation of one or more nerve-centers, may set up pathological change.

Prognosis.—The prognosis as to life depends, of course, on the stage which has been reached and upon the estimate which may be formed of the secondary organic changes that have taken place. Relief of the obstruction, drainage and antisepsis of the bladder, milk diet, renal antisepsis, etc., work astonishing improvement often in apparently desperate cases. Fenwick has forcibly called attention (Journ. of Cut. and Gen.-Urin. Dis., November, 1888) to the fact that text-books of surgery and monographs on stricture are usually silent upon the question of prognosis in those cases of moderate severity in which most doubt would necessarily exist. As he remarks, the pathological effects of backward pressure upon the kidneys, and the results of the extension of inflammation from the bladder to that organ, are faithfully described as the usual outcome of unrelieved or neglected obstruction of the urethra. But no definite rules for ascertaining the progress of these insidious and hidden pressure changes are laid down, and the practitioner is left to surmise or to assume

the stage of their development by the general condition of the patient, by an examination of the urine, or by the duration of the symptoms and narrowness of the caliber of the canal. The consequence is, that in the practical treatment of stricture we concern ourselves merely with the mechanical removal of the obstruction, and do not pause to ascertain if, or how far, the secreting structure of the kidney has been weakened, or rendered susceptible to the invasion of inflammation from contiguous surfaces.

He believes that just as the necessity for ascertaining the presence of residual urine in the vesical atony due to enlarged prostate or nerve lesions is duly impressed upon the student and practitioner, so likewise ought it to be inculcated that residual urine exists in most cases of stricture of the urethra, and ought to be measured; that its removal is of value in enabling the vesico-ureteric muscles to regain power, and in preventing the establishment of chronic cystitis and calculous formation.

He emphasizes the fact that, in the obstruction offered to the overflow of urine by the unrelieved stricture, three muscular systems—the vesical, ureteric, and cardiac—become successively affected with hypertrophy. This increase of expulsive power is rarely of long duration, for that stage in which the compensatory hypertrophy is insufficient to cope with the resistance is reached, and relaxation and atony supervene. The cardiac condition is contingent upon the renal changes, which in their turn depend upon the failure of the barriers to backward pressure which healthy or hypertrophied vesico-ureteric muscles present. Hence the importance of estimating the condition of these dike-like muscles.

Their energy or incapacity may be appreciated by ascertaining the absence or presence of residual urine, and a systematic measurement of the same at each step of the dilatation, besides affording an index to the recovery or atonicity of these muscle planes, will reckon roughly the amount of backward pressure which has already fallen upon the kidney.

With these ideas in mind, Fenwick made careful examinations of the amount and character of residual urine in seventy-five cases of organic stricture of the urethra, with the following interesting results: Residual urine was found in all the cases examined except five. From this we may argue that residual urine exists in varying proportions in ninety-three per cent of stricture. But if the patient is young (under thirty), if his stricture is of short duration, and the caliber only about half diminished (arbitrarily taking the normal size as 24 French), then all the urine can be expelled.

Twenty-eight per cent of the patients were found to retain only a very small amount, about one to two drachms.

It is to be remarked, however, that these patients were mostly young,

and that the caliber of the canal was of fair size, for in four only was the stricture so small as to require a guide.

In a certain number (i. e., sixty per cent) the amount of residual urine was large. These patients had strictures of small caliber admitting only a fine bougie at the first sitting. It is to be noted that all (except one) were over the age of thirty. Thirty-two ounces was the largest amount withdrawn. The average amount was 6.4 ounces.

Although the duration of the symptoms and the narrowness of the stricture were powerful factors in the production of the atony on which the residual urine depended, yet the age of the patient seemed the most important predisposing cause. The ultimate recovery of tone by the bladder wall seems likewise to be more influenced by the age of the patient than by any other factor. It might have been supposed that in cases which did not recover themselves after release from backward pressure there would be found a history of repeated retention, or at least of a single great over-distention which had materially weakened the bladder wall, but this was not the case. Many of the patients whose atony was the worst had never had retention at all. The bladders of the older patients suffered most without regard to the past histories. This fact is expressed as follows: Given three patients at the ages of thirty-five, forty-five, fifty-five respectively; let each become the subject of stricture and be examined at the end of six months. It will be found that there will be a diminution of expulsive power for each decennary, and a correspondingly increased accumulation of residual urine. There are, of course, other factors which have to be remembered, and for which allowance must be made—e. g., the lowered vitality of the lumbar center from masturbation, excessive venery, abuse of alcohol, and the loss of control consequent upon cerebral or spinal lesions.

The precautions necessary in studying these cases are as follows: A blood-clot or plug of mucus, or a previously blocked catheter, will cause the practitioner to register *no* residual urine, while a clear instrument may withdraw many ounces.

It is of the utmost importance, in order to secure accuracy, that the patient should hold his water for some time previous to the examination.

If a slightly atonic bladder be partially empty when the patient starts to urinate, a great deal of the mechanical force obtained from the counter-pressure of moderate distention is lost. The ejected urine will therefore be small in quantity and the residual large.

The conclusions at which Fenwick arrived in his excellent paper, which on account of its practical value I have used freely, are as follows:

In estimating the health of the kidneys from the indications afforded us by the examination of the residual urine, two items have to be clearly borne in mind. There is, first, the amount of pressure which the kidneys

have been working against. This is to be measured by the quantity of residual urine. Without a careful comparison of the weight, size, and microscopy of the post-mortem kidney with the amount of residual urine noticed before death, and the duration of the stricture, no formula can be constructed to indicate the amount of damage which a definite quantity of residual urine will effect upon the secreting structure of the kidney. It may be safely assumed, however, that five ounces of residual urine, which is probably near the average of unreleased narrow strictures, would indicate sufficient damage to cause anxiety as to the effects of any intercurrent inflammation or disease; while an amount over ten ounces would make us cautious in operating for stricture by internal urethrotomy, and in giving anything but a grave prognosis of the ultimate effects of the constriction. Secondly, the behavior of the muscles in their progress toward recovery will teach us much as regards the future course of the case. A disposition to relapse, or sluggishness in recuperation, would cause us to look forward with apprehension to that period of life when fatty and senile changes step in to aggravate greatly the weakness of an organ upon the health of which old age is mainly dependent. Lastly, we are amply justified when the initial amount of residual urine is under five ounces, when the initial recovery is smart, and the duration of the ultimate recovery short, in giving a good prognosis, provided the full caliber of the urethra be maintained.

Treatment of Stricture.—The various plans which may be employed in the treatment of stricture may be divided into—1. Gradual dilatation. 2. Internal urethrotomy. 3. External urethrotomy. 4. Combined internal and external urethrotomy. 5. Perineal section. 6. Miscellaneous methods, including divulsion, rapid dilatation, electrolysis, excision, urethrectomy, etc.

Gradual Dilatation.—The instruments required for the gradual dilatation of stricture are few and simple. They consist of a set of whalebone filiform bougies with straight, angular, and spiral ends (Fig. 5), a set of

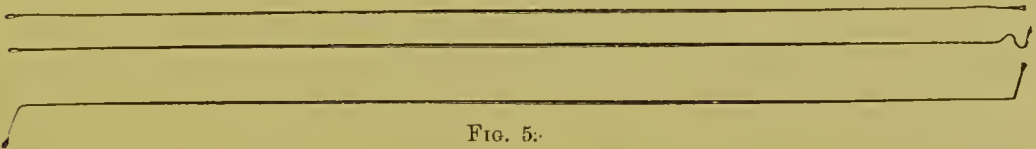


FIG. 5.

tunneled catheters (Fig. 6); ranging from No. 8 or 10 to No. 18, French; a set of Thompson's conical steel sounds, running from about No. 12 to No. 36 or 38 French * (Fig. 7); and a number of flexible bougies of different sizes, the best being the black ones of French manufacture, and

* For economy only alternate numbers need be procured at first by young practitioners, although it is always convenient and occasionally necessary to have the entire set.

with slightly bulbous tips (Fig. 8). The principles of urethral antisepsis should be rigorously applied in the use of these instruments. They should always be vigorously scrubbed with soap and water both before and after use. The steel instruments should be boiled from fifteen to twenty minutes in water containing one per cent of washing soda, to prevent rusting. The

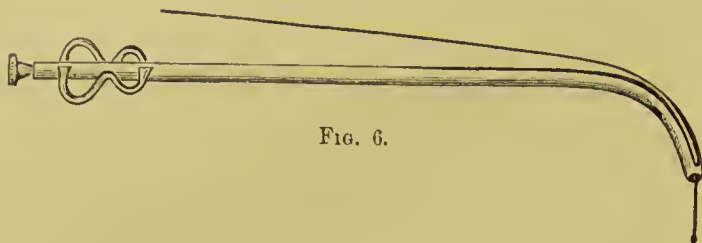


FIG. 6.

rubber and whalebone instruments should be soaked before using in a 1-to-1,000 sublimate solution. The lubricant employed should be either aseptic or antiseptic. An ointment containing one drachm of boric acid to an ounce of carbolated vaseline or cosmoline is extremely useful for this purpose. Freshly prepared carbolized olive-oil (one part of the acid to thirty or forty of oil) is also useful, but loses its antiseptic properties in a short time. Whenever the bladder has been already infected, if the urethra is permeable it is an advantage to precede the

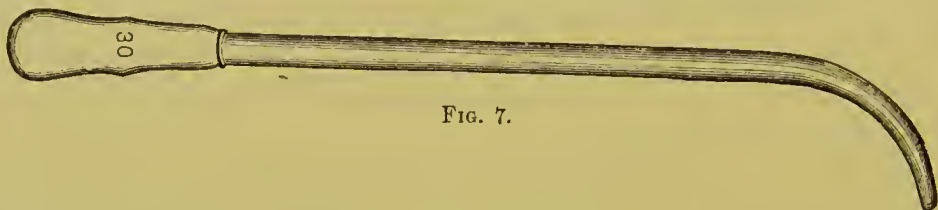


FIG. 7.

systematic treatment of the stricture by irrigation with a dilute sublimate solution (from 1 in 50,000 to 1 in 20,000); potassium permanganate ($\frac{1}{10}$ - to $\frac{3}{10}$ -per-cent solution), boric acid (10 to 20 grains to the ounce of boiled water), hydrogen peroxide (from 1 in 10 to 1 in 2), or silver nitrate (from 1 in 15,000 to 1 in 500). These are among the best antiseptics to be used for this purpose.

At the same time the internal administration of antiseptics is of great value.

I have learned within a few years to place much dependence upon salol and boric acid, in ten-grain doses four to six times daily.

Salhi (*La Semaine med.*, April 7, 1886) showed some years ago that the resultants of the intestinal decomposition of salol are salicylin and



FIG. 8.

carbolic acid, which are eliminated by the kidneys. He had exposed to the air for some weeks the urine of a patient under the influence of salol without the least decomposition occurring. Nencki had made the same observations. Bouchard (*Therapeut. des mal. infectieuses, antisepsie*,

1889, page 247) called attention to the value of the simultaneous employment of several antiseptics in internal administration. Dreyfous (*Gazette hebdomadaire de médecine et de chirurgie*, January 4 and 11, 1890) further emphasized the value of antiseptics of the urinary organs by the internal administration of remedies; and Ernest Lane (*The Lancet*, March 22, 1890) followed him with corroborative statements.

Palmer had already shown (*American Medical Practitioner*, August, 1887) the value of boric acid in sterilizing the urine, having had but one case of urethral fever in forty urethrotomies, and that occurring in a patient in whom by accident the boric acid had not been administered. The well-known effect of quinine in preventing urethral fever is probably due largely to its antiseptic action and to its elimination through the urinary apparatus (Reginald Harrison, *Lectures on Stricture*, 1888).

These facts led me long ago to the systematic employment of these drugs in all my urethral and vesical cases, and I am entirely convinced that I have noticed in all of them a more or less marked influence for good. On the other hand, Albarran (*Annuaire des maladies des organes génito-urinaires*, January, 1890) claims to have demonstrated that urine passed by patients who have absorbed large quantities of salol has no bacterioid power and contains pathogenic microbes. Petit and Wasserman (*ibid.*, July, 1891), at Guyon's instigation, conducted a series of experiments in urethral antiseptics by the direct method, and inoculated bouillon tubes with mucus taken from the urethra after thorough irrigation with sterilized water—four-per-cent boric acid solution and 1 to 1,000 nitrate-of-silver solution. In every instance the tubes showed numerous microorganisms at the end of a week. Keyes, who quotes these statements (*Medical News*, Philadelphia, 1891, ii, page 505), hopes, however, that surgeons will not be deterred by these facts from employing all antiseptic precautions. He has been using, in addition, diuretin, and has employed it in thirteen cases. His plan is to give sixty grains of salol per day for forty-eight hours before operating, and commence diuretin on the day of the operation, giving it in ten-grain doses every four hours for two days. Its value requires to be tested by fuller experience, but he thought the evidence pointed to a certain degree of usefulness to be expected from its employment.*

This preliminary preparation having been attended to wherever possible, and the stricture, if its caliber will permit, having been located and measured by the bulbous bougie in the manner above described, a sterilized conical steel sound, a few sizes larger than the bulb which has passed the stricture, should be warmed to the temperature of the body and oiled

* He still more recently (July, 1892) notes a failure to prevent urethral fever by means of diuretin.

with an antiseptic ointment or with 1 to 40 carbolized oil, and should be carefully introduced through the stricture.

The fixed curve of the urethra—i. e., the curve assumed by the majority of adult male urethræ—in a condition of rest is measured from just in front of the triangular ligament to the neck of the bladder. It is that of a circle three and a quarter inches in diameter, and is represented by an arc of such a circle subtended by a chord two and three-quarter inches in length. This curve may be lessened somewhat by depressing the urethra by means of a finger at either side of the root of the penis; it is always lengthened in cases of hypertrophy of the prostate, or when the bladder is greatly distended. It may be temporarily obliterated, as when a perfectly straight instrument is introduced into the bladder.

Catheterism.—The passage of a properly made steel sound or silver catheter, the curve of which corresponds, as it should, with that given above, is one of the minor operations of surgery most frequently required, and therefore one of the most important. For its performance the patient should, whenever possible, be placed in a recumbent position, the head and shoulders slightly elevated, the knees a little separated, the muscles relaxed.

The surgeon, if right-handed, stands at the left side of the patient. The sound or catheter, thoroughly sterilized, well warmed, and lubricated with some aseptic oil or ointment, is taken in the right hand, the penis between the thumb and fingers of the left hand. The organ is gently put on the stretch, care being taken to keep the dorsum facing the abdominal wall and to avoid any twists in the urethra which would constitute obstacles to the instrument, the point of which is then engaged within the meatus. At this time the shaft of the sound or catheter should be parallel to the line of the groin. This direction is important chiefly in cases of catheterism of persons with large, protuberant bellies, in whom, if it is not followed, the point of the instrument will be made to catch in the upper wall of the triangular ligament, owing to the elevation of the handle necessitated by the protrusion of the abdomen. The handle should in any event be kept low until the tip of the instrument is about to enter the membranous urethra. The penis is drawn up with the left hand while the instrument is gradually pushed onward, the handle being finally swept around to the median line, the shaft being kept parallel to the anterior plane of the body and nearly touching the integument. The instrument is now pressed downward toward the feet, while the left hand still steadies the penis and makes slight upward traction. After four or five inches of the shaft have disappeared within the urethra, it will be found that the downward motion of the instrument is arrested. The fingers of the left hand can then be shifted to the perinæum, where the curve of the instrument can be felt behind the scrotum.

The handle may then, and not until then, be lifted from its close relation with the anterior abdominal wall and swept gently over in the median line, describing the arc of a circle, while the left hand acts as a fulcrum over which the curve of the instrument glides. After the shaft has reached and passed the perpendicular, the handle should be taken in the left hand, and the index and middle fingers of the right hand should be placed one on either side of the root of the penis, making downward pressure, while the left hand, depressing the handle, carries the point of the instrument through the membranous and prostatic urethra into the bladder. Its entrance into that organ will be recognized by the free motion that can be given the tip of the instrument when the handle is rotated, and by the latter remaining exactly in the median line and pointing away from the pubes when the hold upon it is relaxed.

The whole manœuvre should be done with gentleness; no force whatever is necessary.

If there is spasm of the circular fibers of the urethra at any point, or, as is often the case, of the compressor urethræ at the bulbo-membranous junction, a little delay will be followed by relaxation. At this same region, where the large and movable bulbous urethra contracts as it passes through the ligament, the onward pressure of a bougie or catheter is more often arrested on account of unskillfulness on the part of the operator than at any one other point. If the handle be lifted too soon from its proximity to the abdominal wall, the tip of the instrument catches in the subpubic ligament above the urethral orifice; if the handle is not raised at the proper time, or if the fingers in the perinæum do not give the curve of the instrument the gentle upward pressure that it needs, the tip buries itself in the loose and movable floor of the urethra below the orifice. In either case the curve protrudes unnaturally in the perinæum. The gentle withdrawal of the instrument for an inch or two and its reintroduction, raising or lowering its tip as may be required, will usually suffice to overcome this obstacle.

In cases of enlarged prostate a catheter with a much longer shaft and larger curve will be required, or a Mercier catheter (Fig. 9) will be found useful. In stricture a large variety of sizes and shapes may be employed. If the contraction is small and tor-



FIG. 9.

tuous, the most useful instruments are the whalebone filiform bougies, which may be used straight; or, better, with a slight angle given them near the tip (Fig. 5), as the orifice of a stricture is usually eccentric—i. e., not in the middle or center of the obstruction. It is very rare that one of these will not pass. The tunneled catheter (Fig. 6) and the ordinary steel sound are indispensable instruments in the treatment of these cases.

If the instrument is used with ordinary care and gentleness and has been properly sterilized, and if in passing it through the deep urethra the fingers of the left hand of the surgeon are used as a fulcrum in the perinæum and the long end of the lever is depressed with slowness, while the conical point representing the short end is made to follow accurately the subpubic curve of the urethra, the production of prostatitis, epididymitis, or urethral fever, the three most common complications of rough or clumsy instrumentation, will follow with the extremest rarity. In the majority of cases these complications are due to the use of force in the introduction of the bougie (when it practically becomes a divulsor and is very objectionable), or to a slovenly disregard of antiseptic details in the use of urethral instruments, which is not uncommon.

Sometimes a few drops of blood will follow the withdrawal of the instrument. Usually the next act of urination will be slightly painful, and often the gleet discharge, which has caused the patient to seek treatment, will increase for a day or two. The use of an instrument in this manner is always followed by a slight and transitory hyperæmia of the region about the stricture, during which period in many cases, particularly recent ones, appreciable softening and absorption of stricture tissue occur. This period lasts for from three to four days, and only when it begins to subside should the instrument be reintroduced. Ordinarily, an advance of one or two numbers of the French scale may be made each time, but occasionally the same instrument must be introduced at several sittings before it can be exchanged for a larger one. This should be determined by the degree of resistance experienced during its introduction, the pain which it excites at the time and subsequently, and the presence or absence of bleeding. Personal experience soon becomes the best and safest guide as to the degree to which dilatation may be carried at any particular sitting. The feelings of the patient should always be consulted. I am distinctly of the opinion that the statement often made (Keyes, *op. cit.*) that there is no advantage in the retention of the instrument after its passage through the stricture is a mistaken one. It is not reasonable to suppose that the *full* effect of dilatation is obtained by the presence of a sound for a few seconds. It is well known that in continuous dilatation the continued presence of even a filiform bougie greatly softens and enlarges the stricture, and to a certain extent the same effect may be obtained by leaving a steel sound *in situ* for five or ten minutes. The point may be withdrawn a little during the time, so as to avoid irritation of the prostatovesical region. When the full size has been reached (following the table given on page 283 as an approximate guide) the symptoms will usually disappear, and after this it is only necessary to carry on the dilatation at longer and longer intervals to maintain the cure. Most surgeons whose patients are of average intelligence have no difficulty in

teaching them to use such an instrument for themselves, and the majority of my patients do so without the least discomfort or inconvenience. A certain proportion of cases under this plan of treatment will get entirely well, so that years afterward no trace of stricture can be discovered. Others, if the intervals between the introduction of the sound are too long, will have slight recontraction, evidenced possibly by a recurrent gleet, but the rule is that with ordinary care a practical cure is attained by this method in the great majority of cases. The process which is set up by this treatment is that long ago described by Voillemier as "inflammatory atrophic dilatation." Desnos and Kirmisson (*op. cit.*) do not think that in the present state of our knowledge it can be definitely stated whether or not the inflammatory reaction softens the fibrillar cells and brings about their absorption, thus robbing the stricture tissue of its contractile power, but consider it certain that some physio-pathological process occurs, which gives a certain degree of permanency to the results of slow dilatation, either continuous or gradual, which is not seen to follow the various methods of rapid dilatation.*

The practical advantages of the method are obvious, and have for many years held for it the first place in the estimation of those surgeons whose aim is to effect a cure or at least cause the disappearance of all symptoms, while at the same time they minimize the danger and inconvenience to the patient, who even in those cases in which an entire cure is not brought about remains master of the situation.

The introduction of a bougie into any stricture which it fills without causing laceration is accompanied by certain phenomena. There is felt at the end of a few minutes a difficulty in withdrawing the instrument. Soon the spasm disappears, and movement of the bougie becomes easy again. Afterward a muco-purulent discharge is established in the canal, and usually the stricture permits the passage of a larger bougie. The enlargement obtained is evidently not the effect of the pressure exercised by the bougie, since this may have been in no wise tightly grasped; it is the result of the inflammation excited in the stricture by the presence of a foreign body. By the action of bougies of gradually increasing size

* Taylor thinks that the great majority of soft strictures can be cured by a slow intermittent course of gradual dilatation. This treatment, however, takes much time, and many patients will not faithfully follow it. When, however, it can be carried out, a permanent cure will result in many cases. Even in cases of penile stricture there are many that can be cured with a straight sound aided by pressure and manipulation of the stricture over it. Keyes agreed as to the value of dilatation, and considers the operation of cutting as one of necessity to be used only in cases of exigency. He is sure that moderate strictures are cured by dilatation. Bryson heartily indorses the method of dilatation in treating strictures, characterizing it as the ideal way, and the one procedure that could not be eliminated from any method we may adopt for the treatment of these lesions, which it sometimes cures (*Jour. Cut. and Gen.-urin. Dis.*, July and August, 1889).

the work of resorption continues, the contractile elements atrophy, and the urethra sometimes resumes its normal caliber (Duplay, *International Encyclopedia of Surgery*, vol. vi, pages 465, 466).

These remarks apply to any stricture in which the conditions of marked resiliency, or of peculiar susceptibility to instrumentation giving rise to rigors and urethral fever, do not exist, and in which the stricture is not complicated by the existence of abscess, fistula, urinary extravasation, etc. As to the treatment of such a stricture, if it be of large caliber and if it occupy the region at or behind the bulbo-membranous junction, there is scarcely any difference of opinion, the above views being those of the vast majority of surgeons. If, however, it is in the pendulous urethra, gradual dilatation is rejected by a number of very competent men of large experience in favor of internal urethrotomy. The details of that operation will be described later (see page 304), but it will be necessary briefly to discuss here its alleged merits, which in my opinion are somewhat extravagantly vaunted by its advocates, while its undoubted dangers are sometimes ignored. I do not refer so much to the danger to life, though, as has been conclusively shown, that does exist in a definite percentage of cases, but rather to the curvation of the penis, the defective expulsive power causing dribbling after urination, etc., which not infrequently follow extensive urethrotomy.

It must be remembered that no special advantage is claimed for this operation unless it is extensive, the figures of Otis being usually adopted by the few practitioners who habitually employ urethrotomy in stricture of large caliber in which no contra-indication exists to the method of dilatation above described. As to the mortality, Watson's figures (collected by an advocate of the operation) (*Boston Med. and Surg. Jour.*, December 29, 1887), show fifty-one deaths in twenty-five hundred and forty cases, or two per cent; but they include the statistics of all the extremists, whose operations were often on physiological narrowings, and therefore in patients with sound urinary tracts. There is not a more able or skillful genito-urinary surgeon in Europe than Guyon, and his experience is enormous; but we find that he had twenty deaths in four hundred and fifty-nine operations, or about 4.1 per cent. Stein places the mortality in internal urethrotomy of the penile urethra at from two to five per cent (*Trans. of the Am. Assoc. of Genito-urinary Surgeons*, 1889). Thompson had six deaths in four hundred and thirty operations.

A review of a large number of reported cases, and familiarity with a considerable number even less favorable and not reported, lead me to believe that these figures rather underestimate the mortality, and that the practitioner who decides to cut a stricture anterior to the bulbo-membranous junction must do so with the full knowledge that there are at the very least two chances in the hundred of losing his patient. There

should certainly be definite and well-grounded reasons for accepting this risk, and the operation which involves it should show results unmistakably superior to those of gradual dilatation—a procedure with practically no mortality at all.

It may be admitted that as regards stricture of the penile urethra scrupulous attention to antiseptic precautions may possibly lessen somewhat the rate of mortality given above; and the evidence, though not conclusive, is also in favor of the assertion that the probability of effecting a permanent cure by internal urethrotomy is much greater here than elsewhere; but such a cure can only be expected in a limited proportion of cases. It is not in accord with other pathological observations to suppose that the mere division of a dense and old contractile band of fibrous tissue will result in its absorption, and my belief is that the majority of the true strictures of the spongy urethra which are cured by internal urethrotomy are those in which the division of the stricture is supplemented by the use for some time of full-sized bougies. The relief of tension afforded by the section of the stricture gives full play to the so-called “inflammatory atrophic dilatation,” and in a certain proportion of cases either retrograde metamorphosis and absorption take place, or at least a thinning and weakening of the fibrous band, which results in its practical disappearance as a cause of obstruction. I am compelled to believe, however, on both clinical and pathological grounds, that the great majority of so-called strictures of the pendulous urethra which are cut by the extremists in urethrotomy are points of physiological narrowing, and that the so-called “cures” are merely illustrations of the fact that by a linear incision into its long axis we can put in the normal urethra a longitudinal splice of fairly healthy tissue which has but little tendency to contract afterward, and can thus more or less permanently enlarge the urethral caliber. This fact also explains the freedom from fatal results claimed by some surgeons who find strictures and do urethrotomies in the great majority of their cases of chronic urethral discharge. As there has been no real interference with the genito-urinary functions, there has been no development of renal or vesical disease, and the urethra can be operated upon and the “splice” introduced with comparative impunity.*

* “Slight encroachments upon the urethral caliber when submitted to internal urethrotomy are not, as a rule, attended with the same inconveniences that follow the operation upon narrow strictures, but strictures of large caliber rarely require cutting unless indeed a superficial contracting band occasion sufficient reflex disturbances to require prompt relief. As to the ultimate results, thorough dilatation compares most favorably with urethrotomy” (Stein, *op. cit.*).

Agnew says (Principles of Surgery, p. 492): “However valuable may be incision, it must not be deemed a radical cure for stricture, notwithstanding what is said to the contrary by sanguine urethrotomists. The ‘splice,’ of which so much is said, and which occupies the gap between the sides of the divided parts, is granulation tissue; and the re-

It is difficult to see, however, why such a splice should prevent the steady contraction of a mass of old cicatricial tissue, such as occupies the wall of the canal and the periurethral space in strictures of some standing.

Mr. Harrison has called attention (*op. cit.*) to the damage that the urine is capable of exerting while the process of repair in a wound is going on. He adds :

“And what applies to the healing of wounds inflicted accidentally upon the urethra internally, applies equally to others similarly inflicted on the canal for surgical purposes. I have elsewhere stated that for many years past I have taken pains in collecting and noting cases of urethral stricture with the view of estimating the permanency or otherwise of the treatment to which the patient may have been previously submitted by various surgeons. The testimony that I have thus gathered from the examination of many hundred cases is certainly not favorable either to the permanency or the character of the relief that internal urethrotomy usually affords. Among the worst cases of stricture that I have thus met with have been those which have been treated by an internal section.”

The proportion of cases in which true strictures of large caliber in the pendulous urethra require internal urethrotomy varies with the character of the patients among whom the surgeon practices. In hospital and dispensary service and among the poorer classes generally, strictures will quite frequently be found to have been neglected, and will almost always be of long standing before the patient presents himself for treatment, even if they are not of small caliber. They will therefore require urethrotomy in a much larger percentage of cases than will be found among private patients of good social position. Among the latter perhaps not more than one in eight or ten in my own practice need such operative measures, gradual dilatation, as above described, amply sufficing in the remainder to cause the disappearance of all symptoms, and often of the stricture itself when it is of recent formation.* Indeed, even in older cases, as Keyes and others have observed, a notable amount of absorption of the indurated band constituting the stricture can often be seen, and its diminution from day to day can be verified by the touch when the urethra is stretched over a full-sized sound.

We may now consider the application of gradual dilatation to the

sulting cicatrix will always retain that invincible power of contraction. The tendency to coarctation in the canal, it is true, is lessened, but it is not destroyed; and hence the patient must be instructed to pass a metal sound once or twice every month if he expects to keep out of the hands of the surgeon at some future time.”

* Watson (*op. cit.*) finds that the proportion in his practice would be one case of urethrotomy to ten treated by gradual dilatation.

stricture of small caliber (less than 15 French), situated at or deeper than the bulbo-membranous junction.

The diagnosis of these strictures, which are surgically most important, can be made either by means of a bulbous bougie, if it is possible to pass one through the contraction, or by introducing a sterilized sound, well warmed and oiled, down to its anterior face. They will usually be accompanied by gleet and marked vesical symptoms, increasing in severity with the tightness of the stricture. The choice of treatment lies between dilatation and some form of urethrotomy. Divulsion is so clumsy, so uncertain, and so dangerous as to have to-day almost no advocates, and to enter into an argument against it is therefore, in my opinion, a waste of time. I have never believed in it even when, many years ago, it was the favorite method among my seniors at the Philadelphia Hospital, and I have still less confidence in it now.

In beginning the treatment of such a stricture as we are considering, I prefer to attempt first, with great gentleness, to pass through it a steel sound, provided its introduction requires no force whatever. Below No. 8 or 10 of the French scale I rarely go in the use of metal instruments, believing that in the most skillful and experienced hands there is a distinct and unavoidable danger of laceration of the inflamed and degenerated mucous membrane around the strictured region. It is under these circumstances—i. e., in the presence of deep stricture of small caliber—that “false passages” are usually made, and almost always with



FIG. 10.—(Dittel.)

small metallic instruments, either sounds or catheters. The mucous membrane in front of a tight stricture is often inflamed and softened, and if fistulæ have formed behind the stricture diverting the course of the urine, the anterior portion of the strictured region itself, no longer subjected to constant irritation, undergoes atrophy, and a thin-walled dilatation is

frequently found there, which offers but little resistance to the point of an instrument. If, then, the handle of the instrument is depressed too soon, the tip may perforate the upper wall; if too late, the lower wall—the former accident occurring more frequently just anterior to the sub-pubic ligament, the latter in the region of the bulb (Fig. 10).

The sensation conveyed to the hand of the surgeon who has been unfortunate enough to make a false passage differs markedly from that attending a successful catheterism.

The point of the instrument is not in the median line and is held with unusual firmness; there is usually free bleeding almost immediately; the finger in the rectum will usually detect easily the deflection of the instrument, and often the absence of the normal thickness of urethral and prostatic tissues beneath its curve.

The immediate treatment, if there is no retention of urine, should consist in rest, urethral and urinary antisepsis, and avoidance of instrumentation for some weeks.

If I succeed in passing a sound of whatever size through the stricture, I allow it to remain for from five to ten minutes, and then withdraw it. If it is the first experience with the patient, it is best to avoid further instrumentation for from twenty-four to seventy-two hours, in the meantime administering five-grain doses of salol or boric acid four times daily, with a full dose of quinine night and morning. At the next sitting it is often well to recommence with the same instrument, after which one, two, or three larger sizes may be used in succession, if their introduction is easy and is not accompanied by pain or followed by bleeding. Pain and hæmorrhage are unmistakable indications for lengthening the intervals and for proceeding with greater slowness in the use of larger instruments. Savory calls attention to the fact that many cases of stricture of the urethra are overtreated, and that some cases of supposed stricture require no treatment at all.* I have seen many such cases of overinstrumentation, always attended by aggravation of the symptoms.

Once fairly established, however, the treatment by dilatation is carried on as described above, the full normal caliber being usually reached in two or three weeks. If the stricture is not resilient or irritable, or traumatic in its origin, it will be found that all symptoms have disappeared, unless perhaps the gleet persists for a time; but this, too, will finally subside. If the stricture were a recent one, it also may undergo absorption, but in any event the occasional introduction by the patient of a steel sound will always keep the case under control.

* He illustrates his view by the apt story of the physician who, having in consultation discerned a pericarditis, consoled his colleague who had overlooked it with the remark, "My dear fellow, if you had found it out you would have treated it" (*The Lancet*, March 3, 1883, p. 357).

In the case of resilient, irritable, or traumatic stricture in this region, or of stricture which for any reason, as the occurrence of rigors, is non-dilatable, external perineal urethotomy is the operation of choice.

In certain cases no steel sound and no ordinary soft instrument can be made to pass the stricture, but a persevering trial with filiform bougies made of whalebone will result in the passage of one into the bladder. This trial should be made persistently and patiently, and in the absence of retention of urine may be repeated on successive occasions. At the first sitting, a filiform having been passed down to the stricture but refusing to enter it, it should be withdrawn and an angle of 45° put into it by bending it across the thumb-nail from one quarter to one third of an inch from the end (see Fig. 5). As the orifice of a tight stricture is frequently not in the middle of the obstructed urethra, but is to be found at some point around its circumference, this little manœuvre will often enable the surgeon to enter it when with a perfectly straight filiform he can not do so. If this does not succeed, several filiforms should be passed by the side of the first one so as to impinge upon the irregular anterior face of the stricture at a number of points. By attempting to pass first one and then another of these, the instrument bearing the right relation to the orifice will usually be found and passed into the bladder. If this fails, or if one filiform can merely be engaged in the stricture, but can not be made to pass through it, it is often best, in the absence of retention, to tie it in place and allow it to remain *in situ* for twenty-four hours. In the great majority of cases at the end of that time it can be passed with comparative ease into the bladder. There is no objection to still longer delay, or, as I have said, to repeated trials if no urgent symptoms be present. This is certainly better than the repeated attempts at catheterism with small metallic instruments which so often, even in not unskillful hands, result in false passages.

After the first instrument is introduced in such a case four courses are open to the surgeon: 1. He may allow it to remain in place, with the certainty that in one or two days others may be slipped alongside of it and may be used as guides for the introduction, first, of a tunneled catheter, and later of the ordinary soft or steel bougies. 2. He may attempt to conduct a tunneled catheter over it into the bladder at once, to be followed by gradual dilatation. 3. He may conduct over it a tunneled and grooved staff, and then proceed to the performance of external perineal urethrotomy. 4. He may use it as a guide for a Maisonneuve urethrotomè, and may immediately perform internal urethrotomy.

I have mentioned these procedures in the order of preference and of safety. If the stricture which is being dealt with is not of traumatic origin, and is not known to be specially resilient or irritable, the first method will lead up to the adoption of gradual dilatation with the great-

est degree of comfort and absence of anxiety to both patient and surgeon. Even if there had been moderate retention it is absolutely certain that the urine will pass with increasing freedom by the side of the filiform, and that the danger of the ease so far as retention is concerned is at an end.

Gueterboek (Deutsche. Zeitschr. f. Chirurgie, 1891, page 237) recommends this method of continuous dilatation not only in the cases we are now considering, but also in those of deep stricture with great irritability and sensitiveness to the introduction of an instrument, which is accompanied or followed by hæmorrhage. He thinks it likewise indicated whenever it is advisable rapidly to restore the caliber of the urethra, but contra-indications to urethrotomy exist.

If retention has been complete for a long time and is threatening, and the need for immediate relief is marked, it is well to adopt the second method and endeavor to catheterize at once. Failing in this, the third procedure should be employed in cases of urgency, and in all cases with a history of frequent rigors after instrumentation.

Internal urethrotomy should, in my judgment, be employed only in those cases in which the patient refuses to have the external operation performed. It is attended in the best hands with a distinctly larger mortality than any of the other methods mentioned, and there is to my mind no reliable evidence that it is followed by any larger percentage of real and permanent cures.

This completes the consideration of those strictures to which some form of gradual dilatation is applicable. It leaves, however, a considerable number which may best be treated by other methods.

2. Internal Urethrotomy.—The chief variations in the methods employed in the internal division of stricture have reference to the direction and the location of the incision. This may be made (*a*) from before backward, or (*b*) from behind forward; and it may be made (*c*) upon the roof or (*d*) upon the floor of the urethra.

For operations upon the meatus and within the “navicular” portion of the urethra an ordinary blunt tenotome with convex cutting edge



FIG. 11.

(Fig. 11) is all that is required. For operations at a greater depth a number of instruments have been devised, for each of which some special merit is claimed.

Internal Urethrotomy from before Backward.—Of those intended to cut from before backward, Maisonneuve's urethrotome (Fig. 12), or the modification of it introduced by Teevan (Fig. 13), are the best. They are used with flexible screw-tipped filiform bougies, which are first passed through the stricture into the bladder and then attached to the end of the urethrotome, after which they are pushed in advance of it until the stricture is reached and entered by the tip of the instrument. The knife

is then protruded and made to divide the stricture, cutting on the roof of the urethra.

Teevan's urethrotome and its method of use are described as follows (British Med. Journ., September 20, 1884):

The instrument consists of a grooved staff, which is introduced into the bladder. A triangular blade, with a stylet attached, is made to slide along the groove, and the blade is contained in a double sheath, from which it is protruded when the stricture is reached. In Maisonneuve's original instrument the blade was furnished with a knob, and the groove extended to the end of the staff. The groove in this instrument terminates two inches from the end; it is likewise fitted with a wire stylet, on

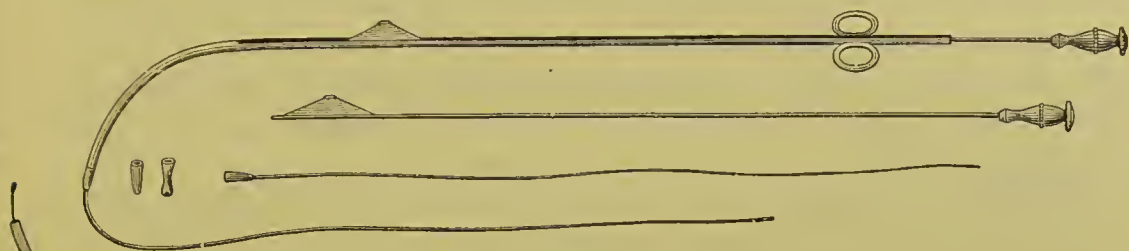


FIG. 12.

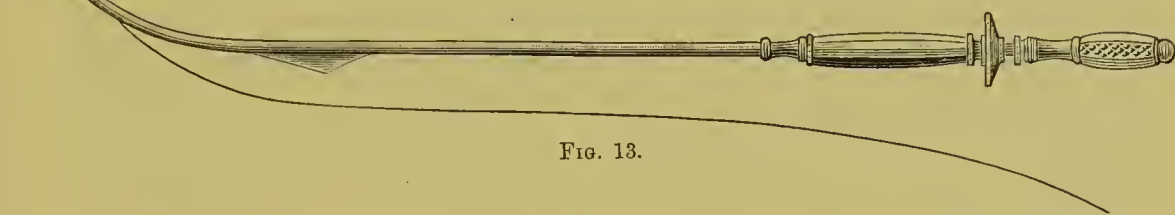


FIG. 13.

the withdrawal of which urine will flow if the instrument be really in the bladder. The knob on the blade is replaced by the double sheath, which increases the knife. The instrument terminates in a small screw, by means of which it can be attached to a conducting bougie which guides it into the bladder. Before making the incision it is of great importance to be quite certain that the instrument is really in the bladder; for, in the absence of such a proof, a false passage might be divided instead of the stricture. After this instrument has been passed, the stylet is withdrawn, and urine will then escape if the bladder have been reached.

The operation is performed in the following manner: A fine flexible guiding bougie, equal in size to No. 4 or 5 French, is passed into the bladder. The staff or sheath of the urethrotome is then screwed on to the guide, passed through the stricture into the bladder, and held in position by an assistant. The operator with his left hand seizes the penis just behind the glans and draws it forward; with his right hand he pushes the stem of the sheathed knife down the urethra until the obstruction is reached; the knife is then protruded, and all resisting

tissue in front of it is divided. The incision is thus made in the roof of the urethra. The knife is then withdrawn into its sheath, which is pushed along the urethra in order to ascertain that the division has been complete. If it be so, the instrument is immediately withdrawn. A full-sized silver catheter is then passed, the bladder is emptied, and the catheter is also withdrawn.

It occasionally happens that some difficulty is experienced in the introduction of the catheter after the operation. In some cases this is due to the staff having been held too far out by the assistant, so that the stricture is not completely divided; but this difficulty will not be experienced if the sheath be found to pass freely through the stricture after division. If it meet with an obstruction, the incision may have to be repeated, but this is undesirable.

With regard to the after-treatment, the ordinary routine is as follows: Immediately after the operation the patient of course remains in bed; hot bottles are applied to the feet, and three grains of quinine are given with half an ounce of brandy. A little beef tea is also given from time to time. If no rigors occur, the patient has a hot bath at night, and forty-eight hours afterward a French bougie corresponding in size to the catheter used after the operation is passed along the urethra. The patient is then allowed to get up. The bougie is passed every three or four days, and at the end of ten or fourteen days the patient is taught how to use the instrument himself. He is kept under careful observation for as long a period as possible.

This represents the best of the methods by which the urethra is divided from before backward.

b. Internal Urethrotomy from behind Forward.—Sir Henry Thompson (The Lancet, June 14, 1884, page 1061) describes as follows his method of performing internal urethrotomy, using his own modification of Civiale's urethrotome; the bulbous end has a mean diameter of No. 5, the stem is about two and a half or three inches; the patient being under the influence of an anæsthetic, a small catheter which has been tied in is withdrawn, and the urethrotome is first introduced as far as to the deep-seated stricture, through which the terminal bulb is then insinuated. It must now be passed fully half or three quarters of an inch in—that is, beyond the stricture—and the blade, being exposed in the direction toward the floor, is pressed firmly thereon, and drawn forward until all resistance, sometimes considerable, is completely overcome. A touch on the button near the handle completely sheathes the blade, and the outward movement proceeds until the site of the second stricture is reached, when another incision is made in the same manner as before. The urethrotome is then withdrawn, and the meatus freely divided by a scalpel or a short urethrotome. A blunt metal bougie or dilator, No. 15 or No. 16

English size, is next used and if possible passed into the bladder. It generally passes at once without obstruction; if, however, its progress is arrested at any point, the situation of this is carefully noted, when the dilator is withdrawn, the original urethrotome reintroduced, and the opposing tissue divided. But this is seldom necessary. The stricture should permit the free and easy passage after the operation of a metallic sound, about No. 27 French in size; and in some cases No. 28 or even No. 30 may remain for forty-eight hours, with an extra twenty-four hours or forty-eight hours if the incisions have been deeper than usual, or if hæmorrhage is free or continuous, the latter being a very exceptional occurrence.

A further modification of Civiale's urethrotome is one known by the name of the late Prof. Gross, of Philadelphia, which I have used occasionally and with satisfaction for many years (Fig. 14). The acorn-shaped head permits of the accurate location of the stricture, and its



FIG. 14.

thorough division may be ascertained at the same time without withdrawal of the instrument. It is, of course, like all the other urethrotomes that cut from before backward, only applicable to strictures that permit of a certain amount of dilatation, the large majority of which, if my views are correct, should be treated by further dilatation and without urethrotomy.

The only other urethrotome which requires mention is also intended to cut from behind forward and at the same time so to dilate the strictured portion of the urethra as to insure the complete separation of every portion of the constricting bands. The method of its employment is described by its inventor, Dr. Otis, as follows: The dilating urethrotome is an instrument (Fig. 15) (constructed on the principle of the ordinary

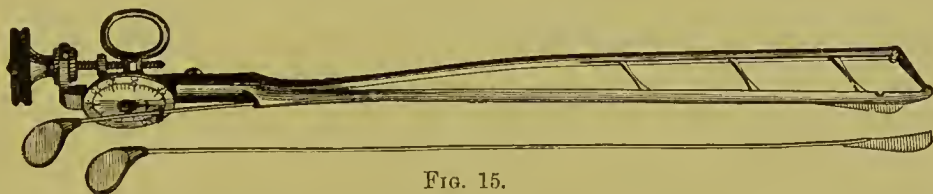


FIG. 15.

parallel rule) which, when closed, measures 18 (French); the bars are separated by means of a screw apparatus at the handle, the amount of separation being registered on a dial at the handle of the instrument. A knife two millimetres in breadth runs in a groove down the upper bar of the instrument, guarded after the manner of the urethrotome of Maisonneuve. The size of the urethra having been ascertained by

means of the urethrometer (or by assuming it from the proportions of the flaccid penis), the urethrotome is introduced beyond the stricture; the screw at the handle is turned, dilating the instrument up to and a millimetre or two beyond the normal caliber, in order to make the strictures completely salient; then the blade is drawn through them, cutting through the entire mass of cicatricial tissue, severing the strictures completely. The diagnosis of stricture is made in every case by the bulbous sound; and freedom from stricture after operation is demonstrated by the free passage of a bulbous sound of a size corresponding with the previously ascertained caliber of the urethra under operation.

c and *d*. As to the choice between the roof and the floor of the urethra as the preferable site of urethrotomy, it may be said with considerable dogmatism, and in spite of the opposing views of such eminent authorities as Sir Henry Thompson, Mr. Buxton Browne, and others, that for the anatomical reasons already given (see page 282) the roof is to be preferred in the portion of the urethra anterior to the bulb. It is claimed in addition that, as the floor of the urethra is the region chiefly affected by the "stricture disease" (Bryson), the incision on the roof is preferable, as permitting of the better and more thorough division of the urethral wall and thus favoring the insertion of the "splice," of which so much has been written.

The discussion as to the best site for the incision in stricture posterior to the bulb is not of so much importance, as the operation is performed in that region with much greater rarity.

Fenwick says (Annals of Surgery, August, 1889) that, owing to the close proximity of the dorsal vein and the plexus of Santorini, hæmorrhage is apt to be extremely profuse and difficult to control when a urethrotomy has involved the upper wall of the deep or membranous urethra. He gives a fatal case of this character. The bulb and its arteries are liable to be wounded by incision in the reverse direction.

The *antiseptic details* of the operation have been formulated by Bruce Clark (The Lancet, October 13, 1888) as follows: 1. The urethra is rendered as pure as possible by previous irrigation, and for several days beforehand, both with hot water and a 1 to 2,000 solution of corrosive sublimate. 2. The instrument which is to be employed should be taken to pieces and carefully scrubbed in soda and water, and soaked in carbolic acid (1 to 20) for at least ten minutes before the operation, and only put together at the last moment, just before it is to be used. 3. When the urethra has been more freely divided a full-sized catheter should be passed into the bladder and retained there for twenty-four hours. The catheter should be a new one, and should be allowed to soak in carbolic acid (1 to 100) for at least twelve hours previous to the operation. In

his series of fifteen cases there was but one rigor, and that was not attended by any severe constitutional disturbance.

Southam (The Lancet, June 14, 1890) has adopted the following plan of preliminary treatment: Internal urethrotomy having been decided upon, the patient is confined to bed and kept upon a milk diet for a few days previous to the operation, the urethra being meanwhile left at rest, and free from the irritation caused by the passage of instruments. To relieve any tendency to congestion of the urethral mucous membrane and parts about the neck of the bladder, the bowels are kept freely open by small doses of magnesium sulphate. A mixture containing boric acid in ten-grain doses is also given three times daily; for in the majority of cases of stricture where operative interference is required chronic cystitis is also present to a greater or less extent, the urine containing more or less pus, and, if not alkaline, being either neutral or only faintly acid in reaction. Under a course of boric acid given internally it will generally be found that the urine, at any rate in the less severe cases, soon regains its normal acidity; at the same time a portion of the boric acid being eliminated by the kidneys, and passing away in the urine, the antiseptic action of the drug is exerted directly on the mucous lining of the bladder. Thus the cystitis is relieved, the pus is diminished in amount or entirely disappears, and the decomposition of the urine in the interior of the bladder is also prevented. The result is that the urine, if toxic, is sterilized or rendered aseptic, and its contact with the surface of the urethral wound after operation is consequently innocuous.

This confidence in boric acid is confirmed by the experience of Palmer (already quoted), and by that of many other genito-urinary surgeons, including myself.

We may now consider the *indications* for the performance of one or the other of these forms of internal urethrotomy. I have already sufficiently stated the reasons which seem to me to justify the rejection of internal urethrotomy as a routine procedure in cases of stricture of large caliber of the pendulous urethra, and *a fortiori* in cases of similar or of narrower stricture in the deep urethra. Of those which remain, we may first consider the strictures of the meatus and of the neighborhood of the fossa navicularis. In this region dilatation is peculiarly unsatisfactory. Owing to the intimate relation between the spongy tissue of the glans and the urethra, to the exceptionally rich nerve-supply to the part, and to the extreme sensibility characteristic of mucous outlets, the stretching of the stricture by means of sounds gives rise to pain, irritation, and inflammation. For these reasons, and on account of the absolute safety of the procedure, it is better to divide all such strictures rather than to attempt to dilate them. I have done so for many years, and have never had an alarming symptom. I desire, however, to record my protest

against the most unnecessary and ill-judged zeal which, as Keyes says, makes it of late years the rule, rather than the exception, for cases of obscure genito-urinary disease to present themselves with traumatic hypospadias, and with the history that their whole anterior urethra has been cut to a size among the thirties, under the assurance that this would cure the malady. He adds, "This is the natural result of the modern fashion of meatotomy and urethrotomy, which has run riot in the profession and led to much unnecessary surgery and to some positive injury." I agree with him and with other competent observers who believe the cutting of true strictures in the anterior urethra to be good surgery, but who think that the division of every point at the meatus and in the first few inches, simply because those points are (as they should be normally) narrower than other points in the canal, is routine surgery of a very unprofitable sort.

The operation of meatotomy is best done with a probe-pointed tenotome with the usual convex-cutting edge. The incision should be made upon the floor of the urethra, and should be sufficient to entirely remove all sense of resistance upon the withdrawal of a full-sized bulbous bougie. It should be a little larger than the caliber which it is desired to establish permanently, so as to allow for subsequent contraction. Like all other operations upon the urethra, it should be done with scrupulous attention to antiseptic details. A short, straight, conical bougie, the so-called meatus sound, should be gently inserted once in twenty-four hours during the healing process. Deeper troubles, unless urgent in their character, should be ignored until healing is complete. Sometimes, but much more rarely than is generally supposed, such troubles, although previously thought to be organic, will be found to have disappeared. In those cases they have probably been due to reflex irritation, but this condition never occurs except in conjunction with a pin-hole meatus or with a distinctly strictured condition of the urethra in its vicinity. I doubt greatly the frequent production of deep urethral spasm as a result of the so-called anterior stricture of large caliber, either at the meatus or elsewhere. I am the more desirous of emphasizing this point as I at one time strongly advocated the opposite view; but, in the light of wider experience and longer observation of cases, I believe I did so upon insufficient grounds.

If strictures of large caliber in the pendulous urethra are of long standing, distinctly fibrous in character or non-dilatable, internal urethrotomy is indicated. Resiliency or resistance to dilatation is indeed the chief indication for a cutting operation on strictures at any portion of the urethral tract, and is far more important in determining the choice of treatment than their caliber; but internal urethrotomy in the pendulous urethra is particularly satisfactory on account of the comparative freedom from danger which has already been alluded to. As to the probability

of effecting thereby a permanent cure, while, as I have already said, it is greater here than elsewhere, such a cure can only be expected in a limited proportion of cases.

Strictures of small caliber (less than 15 French), situated in advance of the bulbo-membranous junction, unless seen very early and found to be unusually soft and dilatable, furnish the typical condition for internal urethrotomy, that in which it is attended with the minimum of danger and with the greatest prospect of effecting a permanent cure. The exceptions to this rule will be noted when the operation of combined internal and external urethrotomy is described. The operation may be performed with the instrument which the surgeon happens to prefer, the essentials to success being a linear division in the roof of the urethra of every portion of strictured tissue, the incision extending from the normal parts behind to the normal parts in front of the stricture. If the contraction is of very small caliber, a Maisonneuve urethrotome may be passed over a filiform guide and a preliminary urethrotomy done, so that one of the various forms of dilating urethrotomes may be passed through it and the stricture freely divided from behind forward. A *bougie à boule* should then be used to demonstrate the complete division of the stricture, a large-size gum catheter passed and tied in the bladder, and bleeding controlled, if necessary, by the application of a firm bandage. The moderate risk attending this operation is reduced to its smallest proportion by the employment of sterilized instruments, the use of urethral irrigation before, and if necessary after, the operation, the administration of internal remedies which tend to sterilize the urine, and by attention to the various details of antisepsis, as applied to genito-urinary surgery.

A few days after the operation a full-sized bougie should be gently passed and should be used afterward, as in cases of dilatation, for some weeks; often it will be necessary to use it at intervals for a much longer period, and in a fair proportion of cases an apparent cure will follow.

These indications for internal urethrotomy will surely be regarded by some surgeons as entirely too restricted, and it seems right to give some illustration of the range which the operation takes in the hands of those who favor its performance. Buxton Browne, who represents Sir Henry Thompson's teaching and practice as well as his own, gives (Brit. Med. Jour., April 16, 1887, page 823) the following indications for its employment:

1. When time is an object. The patient is perhaps ordered on foreign service, or perhaps, on the eve of marriage, finds that he is subject to stricture.

2. When the stricture is at the urethral orifice, or in the penile urethra,

and will not yield permanently to either continuous or interrupted dilatation, but must be divided.

3. In cases of stricture where the gentlest instrumental interference is followed by rigors and great prostration. If the fibers of the stricture are freely divided, the use of a bougie will cease to be followed by rigor. If, after internal urethrotomy, the use of a bougie is still followed by rigor, it will be because the operation has been incomplete, and it must be repeated more thoroughly.

4. Internal urethrotomy is required when a stricture rapidly recontracts after dilatation. If such stricture is obviously large and dense, dilatation is useless, and the stricture must be cut, and sometimes requires more than one cutting operation before a satisfactory result is obtained.

5. When renal or other calculus is impacted behind a stricture, the stricture had better be divided internally, and, if possible, the calculus extracted *per vias naturales*; should this prove impossible, the calculus may be cut down upon, and the division of the stricture and subsequent treatment will prevent the opening thus made from becoming fistulous.

6. No urethral fistula will ever heal as long as the urethra is contracted in front of the fistulous orifice. Divide the stricture and keep it open by periodical instrumentation, and usually the fistula will close.

7. For stricture complicated by prostatic enlargement.

8. Occasionally, as a prelude to lithotomy, to permit the introduction of the grooved staff.

9. In a patient with a tight stricture who is developing a perineal abscess. The urethrotomy is followed by the introduction of a large-sized catheter, and the perinæum is then opened until pus issues, the wound is enlarged and dilated a little with the fingers.

Bangs, in this country, has recently (Medical News, December 12, 1891) formulated the views of the followers of Otis by reserving gradual dilatation for soft, non-fibrous strictures of the posterior urethra and for those of similar pathological character in the bulbous urethra. He states that it is also sufficient in some of the soft, not well-organized strictures in the penile urethra that are practically adhesions of mucous surfaces. In all strictures of large caliber, *requiring interference*,* he advocates internal urethrotomy, making for simple, uncomplicated strictures of small caliber a reservation in favor of the combined operation in certain cases to be described later (see page 319).

Internal Urethrotomy in Children.—De Pezzer (L'Union méd., 1887, page 193) says that in literature he has been able to find only two allusions to internal urethrotomy in children—those of Holmes, who advocates it, but reports no case of it, and Eugene Boeckel, who reports a case of this

* The italics are his.

operation in a boy of twelve, which was successful (Gaz. méd. de Strasbourg, 1876, page 122).

De Pezzer has had two cases—one in a boy fifteen years old, for stricture appearing soon after contracting gonorrhœa, the other in a boy of ten, with traumatic stricture in the perineo-bulbar region. Dilatation and electrolysis failed, but internal urethrotomy was followed by a good result.

He concludes that internal urethrotomy is not contra-indicated, and has the same applications in the child as in the adult, but that the curve of the urethrotome must be modified in degree and length to suit the age of the individual patient.

3. External Urethrotomy.—There has always been more or less confusion in the nomenclature of the perineal operations for the relief of stricture. The old boutonnière operation (of which the so-called "Cock's operation" is a modification) had for its object the opening of the urethra behind the obstruction, was purely palliative, and if it ever effected a cure did so by accident, as the procedure itself did not include of necessity any division or enlargement of the strictured portion of the canal. It was an "external urethrotomy," to be sure, but it is not related either in its purpose or its method to the other operations known by that name.

Since Syme revived and popularized the formal operation of external urethrotomy—the division of a stricture upon a grooved staff passed through it into the bladder—more system has been introduced into the terms employed, but there is still much objectionable looseness. Hunter, Grainger, C. Bell, and others had, before Syme's time, formulated the operation known as "perineal section," which was also an external urethrotomy, but which was then restricted to those cases in which no instrument whatever could be made to pass the stricture. The term should still be reserved for such cases, and on account of its brevity is perhaps preferable to its synonym, "external perineal urethrotomy without a guide."

The opening of the urethra in its penile portion is, as a formal operative procedure, practically unknown. I shall therefore employ the term external urethrotomy to indicate those operations in which the urethra is opened through the perinæum upon some sort of guide. It will only be necessary to describe the two chief varieties of this procedure.

a. Syme's Operation.—The instrument needed will be a grooved staff (Fig. 16) with a narrow terminal part which is passed through the stricture. When this narrow portion joins the shaft there is a "shoulder" which, when the instrument is in position, rests against the anterior face of the stricture. The groove of the staff runs to its extreme tip. A scalpel, a probe, a broad-grooved director, or, better, a Teale's probe

* gorget (Fig. 17), and a catheter, are all that will be required. The operation is described as follows (Treves, *Operative Surgery*, vol. ii, page 626):

The patient is placed in lithotomy position, and the staff is introduced with the care already advised in performing that operation. An incision



FIG. 16.

is made precisely in the median line of the perinæum, and the knife is so directed that its point shall hit the shoulder of the instrument.

The surgeon must convince himself that this portion of the staff is laid bare. He then engages the point of the knife in the groove of the staff, and, keeping most carefully to the groove, thrusts the knife toward the neck of the bladder until he has divided the whole of the stricture. A director or probe, or Teale's probe gorget, is now introduced along the convexity of the staff into the bladder, and the staff is removed. A gum-elastic catheter may then be passed into the bladder through the penis, and be guided by the director or probe gorget aided by the finger inserted into the wound.

Should the irritability of the bladder prevent the retention of a catheter, a tube should be passed into the bladder from the perinæum, and should be retained in position by tapes.

Syme's curved catheter may be employed for this purpose, or a portion of a gum-elastic catheter may be made use of. Whitehead's perineal tube, with sliding adjustable shield, is a useful instrument.

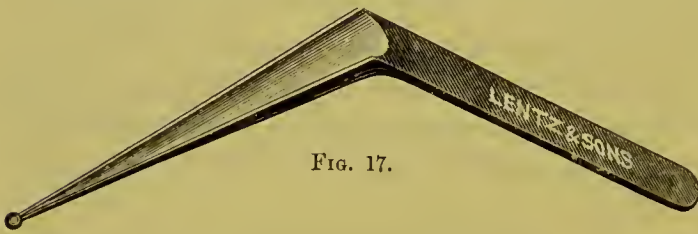


FIG. 17.

As soon as possible, however, a catheter should be passed by the meatus, and the perineal wound allowed to close.

b. Not infrequently cases are met with in which it is possible to pass a filiform bougie into the bladder, but no larger instrument can be made to follow it. In that case a grooved staff similar to Syme's, but with a quarter of an inch of its extremity bridged over so as to convert the groove into a canal—or, better, a "tunneled catheter" staff (Fig. 6)—may be used in the same way.

The operation is performed as follows :

The exact seat of the stricture having been ascertained, the urethra is

filled with olive oil, and a capillary probe-pointed whalebone bougie is introduced into the canal, an attempt being made to pass it through the stricture. If it enters a false passage, it is retained *in situ* by the left hand while another is passed by its side. If this second guide finds its way into a false passage, it is treated precisely as was the first, and the operation is repeated until one bougie has been passed through the obstruction into the bladder. The other guides—often five or six in number—are then withdrawn.

The tunneled catheter staff is then threaded over the free end of the filiform bougie and is gently pushed onward toward the bladder, the guide being held in the meantime between the thumb and finger of the left hand. I have found it a useful manœuvre to release the guide when the strain and friction upon it became greatest, and to permit it to be pushed onward with the staff or catheter. Its end will of course disappear within the urethra, but can almost always be found within an inch of the meatus by pressing the penis backward after the metallic instrument is in the bladder. If it should not be in sight then, it will certainly reappear when the staff is withdrawn.

If the latter can be made to pass through the stricture, the operation is completed precisely as in the Syme operation just described. If not, the tip of the staff is held in contact with the anterior face of the stricture by an assistant, who supports the scrotum, and the patient is brought into the lithotomy position. The surgeon makes a free incision in the median line of the perinæum, and brings into view the urethra, which is opened upon the bridged portion of the staff, the knife following the groove in the instrument. A loop of silk is then passed through each edge of the incised urethra, close to the face of the stricture, and serves to enable the canal to be held open by an assistant. The catheter staff is now withdrawn a little, so as to bring into view the black guide; then the stricture, with about half an inch of the uncontracted canal behind it, is divided by means of the beaked bistoury. The last step consists in passing the staff, guided by the whalebone bougie, into the bladder. The subsequent treatment of the case is conducted upon ordinary principles.

The general indication for external urethrotomy is the existence in the deep urethra of a stricture of small caliber, not amenable to dilatation. The following varieties should be specially mentioned:

1. Tough, fibrous stricture, which will not permit of dilatation to a proper extent.
2. Resilient stricture, which recontracts rapidly after dilatation.
3. Hard, narrow stricture, associated with deep perineal indurations and intractable to dilatation both continuous and intermittent.
4. Stricture complicated with fistulæ, in which dilatation has failed to bring about closure of the latter.
5. Typical traumatic stricture, which is

almost always dense and resilient. 6. Stricture behind which extravasation of urine has occurred. 7. Stricture complicated with perineal abscess, the latter being laid open and the stricture divided by the same incision. 8. Stricture complicated by intense cystitis, so that the advantages of continuous drainage of the bladder may be secured at the same time. 9. Stricture associated with enlargement of the prostate, and refusing to yield to either continuous or intermittent dilatation. 10. Stricture complicated with retention of urine or with the "incontinence of retention." The high degree of atony of the bladder which ordinarily exists in these cases renders perineal drainage exceptionally desirable. 11. Stricture in which urethral fever follows instrumentation, or in which renal congestion or nephritis is known to exist.

It is to be understood, I repeat, that in all these cases the stricture is situated posterior to the bulbo-membranous junction.

As to the *results* obtained by this method the evidence is conflicting, but is sufficient to show that in by far the larger number of cases the canal must be kept open by the more or less frequent passage of bougies, or recontraction will follow. That cure occasionally though rarely follows seems to be fairly well established.

Antal (*Vierteljahrsschrift für Derm. und Syph.*, iv, 1887, page 863) states, however, that as his experience increases he is more and more impressed with the view that the permanent cure of stricture is well-nigh impossible. Dittel is of opinion that, if a stricture be cut, it heals lineally and so does not add to the lumen of the urethra. Guyon believes that the elastic fibers run circularly, and when cut, retract, forming a rhomboidal-shaped lumen, and, a wide interposed scar results, and teaches that the stricture does not recontract. He does not follow by dilatation. Antal says, however, that this theory holds good only in the early stages, as later the elastic fibers have lost their elasticity. His endoscopic studies have shown that, after cutting, a stricture always heals as a linear scar, and that therefore, although the treatment may have been shortened, the lumen is not permanently increased.

Keyes (*Med. Record*, May 25, 1889) says that he has had some cases in which permanent cure seemed to have followed the thorough division of stricture by perineal section, while at the same time he acknowledges the failure of accomplishment of radical cure in a vast majority of the cases operated on. In seeking for an explanation of the difference, he found that there are different forms of organic stricture—the soft, the inodular, and the purely cicatricial fibrous stricture with no inodular masses. His conclusion is that the soft stricture, in which there is no fibrous organic change below the surface of the mucous membrane, but probably considerable spasmodic element, may be radically cured by dilatation or section; pure fibrous stricture only by thorough section, and

subsequent use of large instruments for a considerable time, after which he believes instruments may be given up; inodular stricture, not at all radically, except perhaps after treatment by excision.

Similar expressions of opinion could be quoted from many writers, but the general belief is as above stated—viz., in the possibility but extreme rarity of radical cure.

Combined Internal and External Urethrotomy.—This operation, especially advocated by Mr. Reginald Harrison (*Brit. Med. Journal*, July 18, 1886, page 91; *The Med. Press and Circular*, February, 1889, page 131), is performed as follows: The stricture is divided by means of one of the ordinary forms of urethrotome. The patient is then placed in the lithotomy position, a grooved staff introduced, and the membranous urethra punctured with a long straight knife one-inch in front of the anus, the back of the knife being toward the rectum. The incision is slightly enlarged forward so as to permit the introduction of the index-finger; if the staff be found exposed at the bottom of the wound, as it generally is, all well and good; if not, reintroduce along the finger to the bottom of the wound a somewhat blunt though pointed knife (made for the purpose), with which clear away the few fibers that remain between the tip of the finger and the groove; if a sharp knife be thus used, either the wound is made unnecessarily large or the finger may very easily be cut. The plan of the incision is first to make it fit the finger and subsequently the drainage-tube; if this be done accurately, there is practically no bleeding. When the groove of the staff is felt, Wheelhouse's small probe-pointed gorget is slid along it, the staff is withdrawn, and the drainage-tube passed along the concavity of the gorget into its position. The proceeding thus described is merely for the purpose of drainage and for placing the urethra at rest.

The tube is retained seven to ten days; after the second day it should be taken out and cleansed daily; the bladder is irrigated twice daily with a 1-10,000 to 1-5,000 sublimate solution.

This operation, which Harrison very properly says should be described as a perineal puncture rather than a perineal section, has the great advantage of meeting the indication for the removal of the stricture tissue from the contact with the urine, which, as we have seen, is the essential factor in the production of organic stricture. It should therefore be carefully considered in all those cases of anterior stricture requiring division in which there is marked resiliency or a distinct inodular mass, in those which were traumatic in their origin, and in those which are complicated by fistulæ. The following line of argument (*The Lancet*, London, 1892, vol. i, page 132) in favor of the employment of the combined method in such strictures seems to me incontrovertible: The inflammatory deposit on the surface or in the substance of the mucous membrane, or oftener beneath it, which constitutes the beginning of a stricture, stead-

ily increases little by little as fresh lymph is poured out, around, and beneath it, involving first the urethral and then the periurethral tissues, until at length it forms a definite obstruction. The problem in the treatment is, how to insure the absorption of this deposit without causing the addition of more. Temporary relief may be obtained by division or dilatation, if the lymph is still soft and cellular so that its absorption can be effected without loss of time; this sometimes leads to permanent cure. Nearly always, however, a hardened patch or an open ring is left in the substance of the wall, less elastic than the tissues near, and unable to yield smoothly and evenly when the folds of mucous membrane are straightened out by the passage of urine. This obstruction, combined with the leakage of urine into the periurethral space, is sufficient to keep up irritation and cause the stricture to relapse. Each act of micturition strains and pulls upon the tender tissues around, and furnishes a fresh source of irritation. More lymph is thrown out, and organization begins and contraction is well established before the original induration has had time to disappear. Strictures relapse and recontract not only because they are formed of scar tissue (with a few exceptions), but also because the remains of the old hardened inflammatory deposit act like the little thickened patches or the papillary granulations that are left after gonorrhœa, and begin again the old vicious circle. What is wanted is something that will hasten the fatty degeneration of the old exudation and help the tissues to remove it before the irritation of its presence or the continued contact of urine with tissues, the epithelium of which has been crippled or destroyed, can lead to the formation of any more exudation or cause any fresh trouble. Inflammatory exudation in this region can not be treated as in other parts of the body. Experience has proved that it is necessary to free the tissues from every source of irritation, and to secure for them a long period of complete physiological rest. If this can be done, the hardened lymph will slowly disappear, and the walls of the urethra become soft and yielding again.

Moullin claims to have shown (*The Lancet*, London, September 19, 1891) that cure is by no means uncommon after external urethrotomy, and even goes further, and asserts that not only is this possible, but that under certain circumstances some strictures of the penile urethra are capable of undergoing a process of spontaneous absorption. The occasional success of extreme dilatation and free internal urethrotomy after Otis's plan is probably to be explained in this way: thorough stretching or division of the stricture places the part at rest for a sufficient length of time, and the inflammatory products in the wall undergo fatty degeneration and absorption before they can give rise to sufficient obstruction or irritation to lead to the production of any more; but the result is very uncertain, even in comparatively recent instances.

Now, in old cases, especially if there is more than one stricture, the only plan that will give sufficient rest is by opening the urethra in the perinæum and allowing the whole of the urine to escape without coming in contact with the affected part. Hence the value of the combined method.

In deep strictures it seems to me less likely to be useful, as external urethrotomy, as ordinarily performed, meets the same indications, the incision being carried behind the strictured region into healthy tissue and the retained catheter thus diverting the urine. If for any reason, however, it is desired to shorten the healing of the external wound, or if an extensive external cutting seems inadvisable, the combined operation will admirably meet the requirements of the case and will certainly greatly diminish the risks of internal urethrotomy in the deep urethra. Harrison especially recommends it in "eicatrieial, contractile, and relapsing strictures situated in the deeper portions of the urethra," and claims for it these advantages: (1) It is applicable to the worst forms of urethral stricture when the narrowing is so complete as to reduce micturition to the finest possible dimension, so far as the escape of urine is concerned, and where necessarily only the smallest and most delicate instruments can be used; (2) it provides against rigors and fever and the complications that arise from these; and (3) it tends to improve permanently the conditions of the stricture.

Bangs believes (Medical News, December 12, 1891) that if a stricture of small caliber be complicated by fistulæ, either in the penile urethra or in the perinæum, or if there be indurated eicatrieial deposits posterior to four and a half inches, we should employ the combined operation. The external urethrotomy, in his opinion, serves more than one purpose. It enables us to divide all stricture tissue thoroughly and fearlessly, with a definite object in view, and permits us at the same time to abrogate the functions of the diseased urethra by draining away the urine, drop by drop, without any effort on the part of the urethra or perineal muscles. Thus physiological rest to the whole region is obtained as certainly as we obtain physiological rest for a broken limb when we put it on a splint. The process of healing is rendered a continuous and uninterrupted physiological one, without at any time becoming an inflammatory or disease process. Even in cases that have enormous, hypertrophie, indurated masses in the perinæum and neighboring tissues—masses that are the result of tight or filiform strictures in the bulbous or membranous urethra—the effect of this drainage will be seen in the softening and gradual disappearance of these hypertrophies, sometimes before the perineal wound has begun to heal.

Perineal Section.—This term has been reserved for the operations performed upon stricture which will not admit of even the smallest in-

strument. Such strictures, whether gonorrhœal or traumatic in their origin, are usually deeply seated and to be approached through the perinæum.

Two methods of operating may be described (British Medical Journal, June 24, 1876):

a. Wheelhouse's Operation.—A special hooked staff (Fig. 18) is required, with the probe gorget (Fig. 17), needles, forceps, scalpel, etc. The patient is placed in the lithotomy position. The staff is to be introduced with the groove looking toward the surface, and brought gently into contact with the stricture. It should not be pressed much against the stric-



FIG. 18.

ture, for fear of tearing the tissues of the urethra and causing it to leave the canal; this would mar the whole after-proceedings, which depend upon the urethra being opened a quarter of an inch in front of the stricture. While an assistant holds the staff in this position, an incision is made into the perinæum, extending from opposite the point of reflection of the superficial perineal fascia to the outer edge of the sphincter ani. The tissues of the perinæum are to be steadily divided until the urethra is reached. This is now to be opened in the groove of the staff—not upon its point—so as certainly to secure a quarter of an inch of healthy tube immediately in front of the stricture. As soon as the urethra is opened and the groove in the staff fully exposed, the edges of the healthy urethra are to be seized on each side with straight-bladed nibbed forceps and held apart. The staff is then to be gently withdrawn until the button-point appears in the wound. It is then to be turned round, so that the groove may look to the pubes, and the button may be hooked on to the upper angle of the opened urethra, which is then held stretched open at three points, and the operator looks into it immediately in front of the stricture. While thus held open a probe-pointed director is inserted into the urethra, and the operator, if he can not see the opening of the stricture—which is often possible—generally succeeds in very quickly finding it, and passes the point onward through the stricture toward the bladder. The stricture is sometimes hidden among a crop of granulations or warty growths, in the midst of which the probe-point easily finds the true passage. The director having been passed into the bladder (its entrance into which is clearly demonstrated by the freedom of its movements), its groove is turned downward, the whole length of the stricture is carefully and deliberately divided on its under surface, and the passage is thus cleared. The director is still held in the same position, and a straight probe-pointed bistoury is run along the groove to insure complete division

of all bands or other obstructions. These being thoroughly cleared, the old difficulty of directing the point of the catheter through the divided stricture and onward into the bladder is to be overcome. To effect this, the point of a Teale's probe gorget is introduced into the groove in the director, and, guided by it, passed onward into the bladder, dilating the divided stricture and forming a metallic floor, along which the point of the catheter can not fail to pass securely into the bladder. The entry of the gorget into the latter viscus is signalized by an immediate gush of urine along it. A silver catheter (No. 18 or 20 French) is now passed from the meatus down into the wound, and is made to pass once or twice through the divided urethra, where it can be seen in the wound, to render certain the fact that no obstructing bands have been left undivided, and is then, guided by the probe-dilator, passed easily and certainly along the posterior part of the urethra into the bladder. The gorget is now withdrawn, and the catheter fastened in the urethra and allowed to remain for three or four days, an elastic tube conveying the urine away. After the catheter is removed, it is passed daily, or every second or third day, according to circumstances, until the wound in the perinæum is healed; and after the parts have become consolidated, it requires, of course, to be passed still from time to time to prevent recontraction.

Treves (*op. cit.*, vol. ii, page 630) remarks that the operation requires a good light and infinite patience. There is often some difficulty in detecting the orifice of the stricture, and matters may be complicated by a false passage. The hooking of the button of the staff on to the upper angle of the opened urethra is not always of service. The instrument has to be held by an assistant, and is apt to be in the way. The margins of the urethral wound may be conveniently held aside by long threads which have been passed by means of curved needles in holders.

This operation properly belongs under the head of "perineal section," as it is not only always begun without a guide having been passed through the stricture, but is often of necessity continued by dissection until the urethra is fairly opened, even the probe-pointed director not passing through the coarctation.

b. Cock's Operation.—This consists in opening the urethra at the apex of the prostate, behind the obstruction, no guide having been passed. The patient is to be placed in the usual position for lithotomy; and it is of the utmost importance that the body and pelvis should be straight, so that the median line may be accurately preserved. The left forefinger of the operator is then introduced into the rectum. The bearings of the prostate are examined and ascertained, and the tip of the finger is lodged at the apex of the gland. A sharp-pointed double-edged knife is then plunged steadily and boldly into the median line of the perinæum and carried on in a direction toward the tip of the left forefinger, which lies

in the rectum. At the same time by an upward and downward movement the vertical incision may be carried in the median line to any extent that is considered desirable. The lower extremity of the wound should come to within half an inch of the anus. The knife should never be withdrawn in its progress toward the apex of the prostate, but its onward course must be steadily maintained until its point can be felt in close proximity to the tip of the left forefinger. When the operator has fully assured himself as to the relative position of his finger, the apex of the prostate, and the point of his knife, the latter is to be advanced with a motion somewhat obliquely, either to the right or to the left, and it can hardly fail to pierce the urethra. If, in this step of the operation, the anterior extremity of the prostate should be somewhat incised, it is a matter of no consequence.

It is of the utmost importance that the knife be not removed from the wound and that no deviation be made from its original direction until the object is accomplished. If the knife be prematurely removed, it will probably when reinserted make a fresh incision and complicate the desired result. It will be seen that the wound when completed represents a triangle, the base being the external vertical incision through the perinæum, while the apex, and consequently the point of the knife, impinge on the prostate. The knife is now withdrawn, but the left forefinger is still retained in the rectum. The probe-pointed director is carried through the wound and passed into the bladder.

It only remains to secure this drainage-tube in place by means of two tapes, which are attached to the sides of the tube on the one hand, and to the perineal strips of a T-bandage on the other.

Through the tube the bladder may be washed out.

Indications.—The operation of perineal section in some form is indicated in all cases of impassable stricture. If there are no other complications, the method of Mr. Wheelhouse seems to me to meet every indication. The passage of the staff to the stricture shows the exact site of the latter. The insertion of the threads into the divided urethra serves not only to hold it open and give an opportunity for the discovery of the proximal portion, but also fixes the anterior end and renders it easily recognizable during the operation. The least useful direction which Mr. Wheelhouse gives is that of turning the staff with the concavity of the curve upward, so as to hook it into the upper portion of the urethral wound. The instrument is sometimes in the way, has to be held by an assistant, and it seems to me does not afford much help during the operation.

In cases in which a portion of the urethra has been practically destroyed, in which urinary extravasation has occurred and in which the perinæum is riddled with sinuses, and in those of great urgency from ab-

solute retention and in which no aspirating apparatus is procurable, Cock's operation may be tried. The operation has, however, never been a favorite with me, is sometimes disappointing in the best hands, and, as Treves advises, had always better be abandoned if the urethra is not opened at the first or second trial.

Retrograde Catheterization.—If, during a perineal section, persevering search fails to reveal the proximal end of the urethra in cases of traumatic stricture with practical obliteration of the canal, are suprapubic cystotomy and retrograde catheterization justifiable? I am inclined to answer this affirmatively, though such failures should be most exceptional. Retrograde catheterization was practiced for the first time in 1757 by Verguin, a surgeon of Toulouse, who passed a catheter into the urethra through a pre-existent fistula of the bladder, consecutive to suprapubic puncture, since which time a number of surgeons have had recourse to this procedure; and Sedillot formally expressed his opinion that, "in the absence of a pre-existent fistula, if in the course of an external urethrotomy (perineal section) undertaken for an impassable stricture it were found impossible to discover the posterior end, the surgeon would be justified in doing a suprapubic cystotomy at once in order to practice retrograde catheterization."

If the bladder contains urine, and particularly if it is distended, pressure on the hypogastrium or bimanual pressure with the fingers of one hand on the abdomen and of the other in the rectum will often cause a jet of urine to issue from the proximal end of the urethra and will at once disclose its situation. Hæmostasis in the whole wound, by the use of very hot water, will sometimes reveal the urethra by emphasizing the difference between its color and the surrounding parts, the urethra generally showing much paler. The relation to the pubes and to the lower edge of the triangular ligament should be most carefully borne in mind, the search for the torn end in ruptures or for the portion behind the stricture being frequently carried too near the pubes. The membranous urethra in the adult usually runs through the ligament about one inch below the symphysis and about three quarters of an inch above the perineal center. All guides, however, fail occasionally in certain of these cases, and it is then that suprapubic cystotomy is warranted, as an operation with so small a mortality that the slight additional risk is far outweighed by the advantages to the patient of having even an imperfect restoration of the urethral canal.

Drainage after External Urethrotomy and Perineal Section.—Much difference of opinion exists as to the value of a retained catheter after perineal operations opening into the urinary tract. Many authorities advise that in cases of section for stricture no instrument should be employed, or that, at the most, a short perineal drainage-tube be used. Others

direct that it be kept in for forty-eight hours and then withdrawn. I believe, basing my opinion on a fairly extensive trial of both methods, that the retained catheter is of great value in all operations connecting the bladder with the surface of the body, not excepting certain cases of lithotomy with purulent cystitis. If Spence's caution is observed, and it is not allowed to project far into the bladder, and if it is kept clean and sweet by regular antiseptic injections, it is of the utmost advantage in aiding in the prevention of urethral fever, as has been shown by Keyes, Harrison, Diday, Shield, Davis, Hill, Gueterbock, and many others. The last-named writer suggests (*Zeitschrift für Chirurgie*, Bd. xxv, Heft 415, 1888) the employment of prolonged and frequent antiseptic irrigation or the use of an antiseptic sitz-bath. Of equal importance, in my opinion, is regular catheterization at short intervals, begun after the removal of the catheter first introduced. I have repeatedly seen a decided febrile movement after urethral operations disappear or reappear in accord with the employment or the neglect of the catheter. The traumatic urethritis, which the retained catheter or the frequent use of the instrument is said to give rise to, has almost disappeared from my practice since I have begun the use of antiseptic irrigation in such cases, and particularly since I have paid especial attention to the sterilization of the urine by the internal administration of antiseptics. The sterilization of urine by boric acid, or by salol, is of great importance in the after-treatment of all these cases, and should never be omitted. These remedies are most effective, in my judgment, if combined with full doses of quinine, but either of them is far more useful than quinine alone. They should be given with more freedom and more regularity in urethral and vesical operations.

6. Miscellaneous Methods.—*a. Excision.*—A number of interesting cases of excision, usually for traumatic stricture, have been reported. They have met with a varying degree of success. Heusner has reported two cases—one with slight recontraction, one with apparent cure three years after operation. König, Poncet (who reports nine cases), and others, have recorded similar experiences. The latter writer believes that the indications for urethrectomy are to be found in the existence of marked fibrous periurethral induration encircling the urethra in the perinæum, and in a history of previous operations.

b. Excision with Transplantation of Mucous Membrane.—Wölfler has reported three cases in which he employed Thiersch's method of transplanting epidermis for the radical cure of stricture. The cases were of impermeable stricture, which did not seem to him suitable for internal urethrotomy or for perineal section. The cicatricial area of the strictured urethra was first carefully excised, and afterward the granulating surface was entirely covered with mucous membrane derived from a prolapsed uterus (of which there were two cases on hand). The membrane

was kept in place by a packing of iodoform gauze, lubricated on its inner side with vaseline. (The method of bladder drainage is not mentioned.) Three or four days later the bandage was removed, showing a gray, sticky mass where the mucous membrane had been placed. Three or four days later the granulating area seemed covered as with a veil, and again after four or five days the surface was smooth and shining, like true mucous membrane. One of the patients was seen after a year, having had no intermediate treatment. He urinated in a thick stream. The second did as well, but the observation had not lasted as long. The third died six months after his operation, from double nephritis. Autopsy demonstrated a continuous mucous membrane. The boundary between the old and the new mucous membrane could not be clearly determined. Mensesl, of Gotha, Guyon, and others, have reported favorable results.

Mayo Robson (*Brit. Med. Jour.*, May 7, 1885) describes as follows his procedure in a case which six months afterward took a No. 13 (English) sound without a hitch. The man was etherized and placed in the lithotomy position, when Mr. Wheelhouse's staff was passed down to the stricture, the scrotum held up, and the urethra laid open for half an inch in front of the stricture, which was carefully divided and the urethra laid open for half an inch behind this. The stricture, being thus fully exposed, was found to consist of a fibrous cicatricial band about one fourth of an inch wide, involving mucous membrane, submucous tissue, and bulb tissue. The whole of the cicatrix was excised, and the cut ends of the mucous membrane were drawn together over the gap thus formed and secured by a continuous catgut suture. A catheter being then passed into the bladder, the vertical incision into the urethra was united by catgut, thus closing the canal and leaving a continuous and closed urethra. The last sutures were an afterthought, and perhaps unnecessary, for they gave way on the second day, and the urine partly escaped for some little time by the perineal wound, which healed by granulation, as in the ordinary boutonnière operation. For the first two days after operation the temperature reached 101°, but was afterward normal.

Keyes (*Jour. of Cut. and Gen.-Urin. Dis.*, July and August, 1888) has recorded a case in which he excised a traumatic stricture and implanted a portion of the inner layer of the prepuce. A part of the graft took, and the patient made a good recovery. Fourteen months later there were evidences of stricture, but they were slight, and Keyes thought that the result was in favor of the method of treating long, tight, fibrous, and inodular stricture by excision and grafting.

c. **Electrolysis.**—I have carefully reviewed the entire literature of this subject, including the records of the work of Mallez and Trippier, Newman, and Le Fort, and have no hesitation in saying that the evidence adduced in favor of the method is altogether insufficient to warrant its

general adoption, and does not justify even a belief in its usefulness in the average case. As to the claim that urethral stricture is radically cured by this method, it seems to me, in the light of the investigation of Keyes (N. Y. Med. Jour., October 6, 1888, page 372), Tilden Brown (Jour. of Cut. and Gen.-Urin. Dis., July and August, 1888), and others, simply preposterous. F. Swinford Edwards (Medical Press and Circular, 1888) and Bruce Clark (Brit. Med. Jour., December 7, 1889) have been the most prominent British advocates of the method, but have failed to convince their colleagues on either side of the water of its efficacy.

d. Divulsion (Holt and Voillemier, Dict. des sci. méd., art. Urethra).—This method, once so popular in the treatment of stricture, is now almost entirely abandoned. It is so clumsy, so uncertain, and so dangerous, that it has to-day almost no advocates, and to enter into an extended argument against it would therefore, in my opinion, be a waste of time and space. Under this heading may be mentioned, only to condemn, the procedures known as forced catheterization (Desault, Chopart, *ibid.*), immediate progressive dilatation (Maisonnette, Le Fort, *ibid.*), tunnelization (Hirschberg, of Frankfort, *ibid.*), “rapid dilatation by methodical, rational, progressive, and maintained compression”!! (Thiry, of Brussels), progressive divulsion (Lavaux, Congrès Français de Chir., Paris, 1889, page 521), etc. They all involve rupture of mucous or submucous tissues to an indeterminate extent and at an uncertain point, and have all the disadvantages of internal urethrotomy, with the superadded risks of a lacerated and contused wound as compared with an incised wound.

e. Over-distention of the urethra, as advocated by Dr. Tuttle (New York Medical Journal, October 3, 1891), is performed by a special instrument. While it avoids many of the dangers of divulsion, it would seem that it must produce at least minute tears of the mucous surfaces. The reported results in thirty-five cases were very favorable, and the method seems worthy of further and careful testing.

f. Water (St. Louis Courier of Medicine, March, 1886) and *Air* (Félix Gauron, Thèse, 1889) have been employed as dilating agents, being conducted to the anterior face of the stricture by a catheter with a terminal aperture. The method and results of using the former are described as follows: The catheter is attached to a tube four feet long, connecting with a reservoir about four feet above the bed, containing water at a temperature of from 100° to 106° Fahr.

The patient holds the penis well compressed on the catheter to prevent reflux of the water, and at the same time keeps the catheter end well down on the face of the stricture for the whole time of the *séance*, which lasts from three quarters of an hour to one hour.

On the removal of the water-pressure a filiform is introduced, if possible, using the ordinary modifications of direction and motion to enter

the stricture. The author believes the good result is reached in three ways :

1. Pressure of the water against the opening.
2. Gentle pressure of the instrument, acting as in Guyon's method of "supported catheterization."
3. Effect of the warm water, probably modifying the physiological condition of the stricture tissue.

Thus, in one of his cases he failed three times with cold water, and succeeded the fourth time with warm water. He gives seven cases of gonorrhœal and traumatic stricture, impermeable previously, of which four admitted filiforms after one *séance* of simple hydraulic pressure of forty-five minutes; one admitted it after two *séances* of five minutes each—this was a traumatic case, in which the liquid went over to the bladder, probably the impossibility to pass before was due to deviation rather than stricture of the canal; one case yielded after four *séances* of one hour each; finally, one case of traumatic stricture did not yield to six *séances*, and was treated by perineal section.

Some of the cases were treated subsequently by various methods to *cure* the stricture.

They occurred in the Hôpital Necker—six in the service of Guyon and one in that of Trélat—while the author was *interne* there.

g. Massage has been employed by Antal (Centralblatt für die gesammte Ther., July, 1889), who reports distinct beneficial results in six cases.

h. Cauterization, while it still crops out in the literature of stricture now and then, is antiquated and barbarous, and does not require discussion.

My conclusions as to the treatment of organic strictures of the urethra may be summed up as follows :

1. Strictures of large caliber—that is, of more than 15 French, situated at or behind the bulbo-membranous urethra, are to be treated, almost without exception, by gradual dilatation.

2. Strictures of large caliber occupying the pendulous urethra are to be treated by gradual dilatation when very recent and soft, and by internal urethrotomy when of longer standing, distinctly fibrous in character, or non-dilatable. It is to be remembered that the great majority of so-called strictures of large caliber of the pendulous urethra are merely points of physiological narrowing.

3. Strictures of the meatus and of the neighborhood of the fossa navicularis should be divided upon the floor of the urethra whenever it is evident that they are real pathological conditions producing definite symptoms and not normal points of narrowing.

4. Strictures of small caliber (less than 15 French), situated in advance of the bulbo-membranous junction, unless seen very early and found to be unusually soft and dilatable, furnish the typical condition for internal

urethrotomy, which should be done on the roof of the urethra, preferably with a dilating urethrotome, and invariably with all antiseptic precautions. The operation is especially indicated if the stricture is irritable, resilient, or inodular. Combined internal and external urethrotomy is often of advantage under these circumstances.

5. Strictures of small caliber (less than 15 French), situated at or deeper than the bulbo-membranous junction, should be treated, whenever possible, by gradual dilatation. In a case of resilient, irritable, or traumatic stricture in this region, or of stricture which for any reason (as the occurrence of rigors) is non-dilatable, external perineal urethrotomy is the operation of choice.

6. Strictures of the deep urethra, permeable only to filiform bougies, should be treated by gradual dilatation when possible, the filiform being left *in situ* for some time and followed by the introduction of others, or used as a guide for a tunneled catheter. If the stricture be not suitable for dilatation, external perineal urethrotomy should be performed.

7. Impassable strictures of the deep urethra always require the performance of perineal section. They sometimes can best be treated by excision, followed by the implantation of grafts of mucous membrane.

Stricture of the Female Urethra.—This comparatively rare condition deserves at least a mention, although it has attracted but little attention from surgical writers.

Herman, of London, in 1887 reported to the Obstetrical Society his views, after an examination of the female urethra in fifty-five cases, in which no urinary trouble was complained of. He found that in the majority a No. 17 catheter would pass, and in all but two a No. 14. He related six cases of stricture of the female urethra under his own care. He had collected and arranged in tabular form twenty-three others, which were all that he had been able to find reported. He drew a parallel between the two sexes as to the etiology of urethral stricture, and attempted to show that, while it was commoner in males its causes were much the same in the two sexes. In both it might be the result of injury (these cases being proportionately commoner in women on account of child-bearing), or of the cicatrization of chaneres. In the woman it was sometimes due to the so-called lupus of the vulva. In both sexes the chief cause in young and middle-aged subjects was gonorrhœa. In old women there was found stricture due to general fibrous thickening and induration of the urethra, occurring without any history of gonorrhœa or other discoverable local cause. The author suggested that, as in women the homologue of the prostate gland was the urethro-vaginal cellular tissue, these cases were possibly analogous to enlarged prostate in the male. As to treatment, he found that rapid dilatation was so simple and successful that it was preferable to any other method.

Otis, of New York, is convinced that the foundation of at least the largest proportion of the cases consists in cicatricial deposits, due to lithiasis, at periods often long antecedent to the gonorrhœa to which they are attributed. These strictures are productive of severe reflex irritations and neuroses, which may be attributed to causes quite independent of their relations to the urethra. In such cases Otis suggests the desirability of early exploration of the urethra, by means of the urethrometer or the bulbous sound, to demonstrate the condition present.

Van de Warker (*Medical News*, July 16, 1887) has discussed the subject at length, and gives a brief review of its history, or rather of its absence of history, and urges the importance of examination with bulbous sounds in various urinary difficulties in the female. He offers no opinion as to the etiology of such strictures, but believes that they are both as frequent and as important as in the male. He adds: "Sometimes the constrictions are arranged in series, and Nos. 24 to 27 bulb will slip along in a series of jerks that offer but the slightest resistance to the hands; but more usually one or two of these bands are found located at the middle or upper portion of the urethra. The lumen of the normal female urethra is not the same throughout its length. It is contracted toward the meatus, expanded in the middle portion, and narrows again as it approaches the bladder. The use of the urethrometer proves this. One must not, therefore, allow error to occur from the introduction of too large a bulb, which would move with more freedom at one portion of the urethra than at another. The sensation of meeting and passing one of these bands is so characteristic and unmistakable that there is little danger of error."

In strictures of small dimensions, if the obstruction is sufficient to diminish the stream, this symptom of course persists; but even here it is subject to varying degrees of intensity, amounting occasionally to retention, while it is possible to introduce a fair-sized catheter. In women it is not safe to regard every case of urine retention as hysterical until, after a urethral examination by the bulbs, the passage is shown to be free from strictures, large or small. For the purpose of dilatation he makes use of graduated steel sounds, the same as are used to treat male stricture. The action is twofold—to dilate and to cause gradual absorption of the constricting exudate. In strictures of large size, forcible dilatation or divulsion may be used. The treatment, made two or three times a week, extends over a considerable length of time—from two to three months—but the relief given to the patient by the use of sounds is very satisfactory. As the dilatation of the urethra which they produce is no more important than the absorption caused by their use, the latter implies a more or less prolonged treatment. He believes any one can verify this position upon the subject by the habitual examination of the urethra

with the exploratory bulbs in every case of pelvic disease that presents itself for treatment.

I have no positive opinion based on experience to express upon this subject; but the anatomical conditions seem to me to make it probable that stricture of the female urethra will never occur with great frequency. The subject is, however, worthy of more attention than it has yet received, even if the results of further study should be negative.

DISEASES OF THE PROSTATE.

By W. T. BELFIELD, M. D.

WOUNDS.

THE prostate is so thoroughly protected by surrounding parts that, aside from wounds made by the surgeon, it is rarely the object of mechanical violence, except when contiguous organs, of more vital importance, are simultaneously injured. Its tissue exhibits decided reparative power; even the lacerations produced by forcible and faulty handling of catheter and sound—bathed as they often are with fetid urine—commonly heal rapidly.

Wounds of the prostate contain three sources of peril: infiltration of surrounding tissues with urine; hæmorrhage; septic phlebitis, followed by prostatic abscess or even pyæmia.

Urinary infiltration extends backward into the ischio-rectal tissue, forward into the prevesical space, and into the perinæum; the direction depending upon the involvement of the different fasciæ in the wound. I have seen the entire pelvic contents below the peritonæum, and the perinæum, penis, and scrotum, infiltrated with urine after forcible attempts at catheterism through an enlarged prostate.

Hæmorrhage from the large and numerous prostatic veins may be considerable and its extent unsuspected, because the blood flows into the bladder.

Treatment.—In lacerations of the prostate catheterism is suggested by the lesions: urinary infiltration demands free incision and drainage; hæmorrhage requires hot-water injections and pressure with a large sound. In either case a catheter should be tied in for a day or two, to prevent repetition of the injury. In rare cases hæmorrhage may persist in spite of these measures; in such case perineal urethrotomy affords digital control of the bleeding surface as well as drainage of the bladder.

Several cases of enlarged prostate have come under the writer's care, in which prostate and perinæum were so extensively lacerated by forcible catheterism that the urethra could not be identified even after perineal incision. Suprapubic cystotomy and retrograde catheterism were performed in the earlier cases; in later instances I have passed a trocar and cannula from the perinæum through the prostate into the bladder, and left a drainage-tube in the new passage for several days; a catheter intro-

duced from the meatus has then found the natural channel through the prostate.

Abscess in or around the prostate can generally be evacuated by aspiration from the perinæum; yet the free drainage usually required can be secured only by incision. The body of the prostate, the seminal vesicles, and base of the bladder, can be freely exposed by an incision beginning at the tip of the coccyx and extending around the sphincter ani to the perineal raphé; the rectum is separated by blunt dissection and turned to one side. Should the septic infection have involved the prevesical tissue, a suprapubic incision is needed; this space is most thoroughly drained by carrying a tube from the ventral incision behind the symphysis (on either side of the median line so as to avoid the prostate), and through the perinæum, emerging in the median line an inch or more in front of the anus.

Continuous Immersion in hot water is a most important measure for removing toxic products from a septic wound; it is, in fact, the only rapid way of clearing tissues infiltrated with carriers of pathogenic bacteria, such as foul urine and pus. This method, while not novel, has not secured general adoption, probably because of the usual difficulty of execution; this should not excuse the neglect of so essential a measure. Tissues infiltrated with pus from urinary extravasation (or from other cause) should, after necessary incisions, be immersed in hot water continuously for several hours, if facilities permit—certainly for twenty to thirty minutes several times in the first forty-eight hours. A full-length bath may be required; where such is not available, a portable tub of canvas can be constructed at small expense, placed beside the patient's bed, and occupied by him so much of the time as the circumstances of the case may require. The water should cover the entire area infected, and the usual irrigations be made in the bath. The writer has long employed continuous immersion for cleansing septic wounds in general, and in particular for the after-treatment of cystotomies, urinary infiltrations, pelvic abscess, etc., and considers it the one reliable antiseptic method for septic wounds.

ACUTE PROSTATITIS.

Acute septic invasion of the prostate is commonly an extension of a suppurative process of the anterior urethra; the latter may be acute (gonorrhœal) or chronic. Provocation to the involvement of the prostate may be chilling, sexual indulgence, drink, violent exertion, or the passage of instruments into the deep urethra. Possible contributive factors are direct violence to the perinæum, severe urethral injections, injury by instruments, or calculi.

The symptoms, course, and treatment are elsewhere described (see "Complications of Gonorrhœa.")

CHRONIC INFLAMMATION OF THE PROSTATE AND APPENDAGES, INCLUDING CHRONIC PROSTATITIS, PROSTATORRHŒA, PROSTATIC ABSCESS, AND PELVIC ABSCESS.

All modern works on genito-urinary surgery devote a chapter to chronic prostatitis (often miscalled, by one of its symptoms, prostaticorrhœa), and all contain descriptions of chronic abscess in and around the prostate and epididymis. Yet no author that I have consulted notes the fact that chronic inflammation affecting the prostate is commonly not limited to that organ, but invades a part or the whole of the genital tube proper—seminal vesicle, vas deferens, epididymis—and naturally involves also the connective tissue inclosing this tube. The condition is therefore not merely a prostatitis, but a chronic inflammation of the genital canal, or, to paraphrase the term made familiar by gynæcologists, *of the prostate and its appendages*.

There is, indeed, a complete analogy with the chronic inflammatory conditions of the uterus and tubes so far as morbid anatomy is concerned; pelvic cellulitis and abscess (the so-called periprostatic abscess) are probably less frequent than in the female, though by no means rare; possibly they are still sometimes overlooked in the male, as they were formerly in the female.

Etiology.—Among the causes, gonorrhœal infection seems the most frequent; excessive sexual excitement, chilling, injury to the perinæum (horseback and bicycle riding) seem possible causes. Chronic suppuration in the urethra from any cause is very often propagated to the genital canal; hence stricture occupies a causal relation, and the regular catheterism necessitated by prostatic hypertrophy induces a chronic catarrh of the deep urethra, which is often propagated along the genital tube even to the epididymis.

High living certainly favors this morbid condition, either through constant congestion of the pelvic veins or by inducing the gouty diathesis.

Morbid Anatomy.—As the disease is never fatal except through abscess formation, post-mortem observation of the earlier lesions is rare. In the prostate there have been seen the usual results of catarrhal and suppurative inflammation; the racemose glands and prostatic utricle are distended with secretion mixed with pus, sometimes forming large excavations in the substance of the organ; the parenchyma undergoes either atrophy or a thickening whereby the size and consistence of the prostate are somewhat increased, while its rectal surface may become uneven. Seminal vesicles, efferent tubes, and epididymis may exhibit similar distention, with catarrhal and suppurative products, and are also found to be thickened. The surrounding connective tissue between bladder and rectum, and in the prevesical space, is hard and brawny.

Kirmesson and Desnos have recently called attention to the fibroid thickening of the anterior rectal wall which may accompany chronic inflammation of the prostate.

Symptoms.—These vary extremely in severity with the cause and extent of the inflammation. Two types may be described: in the first, the patient is a man under thirty-five when the disease begins, and the cause is gonorrhœal infection; in the second, the subject is often elderly, and the excitant nongonorrhœal.

In the former case the symptoms are those commonly described under chronic prostatitis; they are mental and physical, the latter due largely to derangement of the urinary, sexual, and rectal functions. There is a painful sense of fullness in the perinæum; dull pain in the rectum and glans penis ("neuralgia of the urethra"), suprapubic region, and down the thighs, aggravated by jolting in cars and wagons, by sitting on upholstered chairs, crossing the legs, etc.

Urination is unduly frequent, and the call to micturate imperative; at the end of the act pain is felt in the bladder-neck, and a trace of blood mingles with the urine, which is followed by a thick, viscid fluid—not semen, but the contents of the distended prostatic glands. This intermittent discharge of a glairy, viscid liquid is the true "prostatorrhœa," though the name is often given to a continuous watery discharge, which seems to proceed less from the prostate than from the membranous and anterior urethra, which may participate in the chronic catarrhal condition.

Sexual desire is commonly decreased, and pleasure much diminished or even absent; ejaculation may be painful, and the semen tinged with blood; involuntary emissions are frequent. Sterility is a possible effect; for, as Fürbringer has shown, the spermatozoa exhibit their vibratile movement only after contact with normal prostatic fluid. It is to be expected, and I have verified the expectation by actual observation, that the secretion of the chronically inflamed prostate fails to arouse their activity.

Defecation is accompanied with such unpleasant, even painful, sensation that some of these patients seek treatment for piles. One of my cases, with typical chronic suppurative prostatitis, had received local treatment for piles for a year without appreciable effect.

Extension of the inflammation to the epididymis induces thickening, sensitiveness, and fleeting pains ("neuralgia of the testicle").

Physical examination shows undue sensitiveness of the entire genital tube and vicinity, the prostate, the suprapubic region, the space between the bladder and rectum (where a brawny hardness is also perceptible), the spermatic cord, and epididymis.

The mental symptoms are striking and characteristic—despondency, even melancholy, quite out of proportion to the physical ailment. While

this is sometimes partly due to the erroneous belief that the prostatic discharges are seminal losses, yet it is pronounced in other cases.

The second type of chronic inflammation of the genital canal is one that I have never seen described. From the fact that all standard authors consider "chronic prostatitis" a disease of men under forty, I infer that this type has not been generally recognized. It occurs at any age from twenty to sixty, though my cases have usually been between forty and fifty years—men who have always been accustomed to high living and sensual indulgence. Gonorrhœa is sometimes denied absolutely, more often admitted in youth, ten or more years before the beginning of present ailment. The symptoms are those of the first type in minor degree, diminution of sexual desire and pleasure and neuralgia of the testicle being among the most constant. Thickening of the prostate and of the epididymis is frequent.

Diagnosis.—Chronic inflammation of the prostate and appendages of gonorrhœal origin is distinguished from other complaints by the grouping of the symptoms just enumerated. The usual demonstration of catarrh of the prostatic urethra, by irrigating the anterior channel, and then having the urine passed in two bottles, should be made. Further proof as to the source of the pus can be obtained by "milking" the prostate from the rectum. Tuberculosis of these organs is the only morbid condition requiring careful differentiation; it is distinguished by the nodular and irregular hardness and extensive thickening in the prostate, seminal vesicle, and epididymis.

The nongonorrhœal type exhibits usually a less pronounced and complete picture; it differs from tuberculosis in the features already mentioned. It may be, however, confounded with the early stage of prostatic hypertrophy, since both are common after the fortieth year; indeed, they may coexist in the same patient.

Prognosis.—This condition involves no peril to life except through abscess formation, and even then is not commonly fatal. Yet complete local recovery can not always be assured; the more recent and acute cases are the most favorable. Those in which the prostate alone is involved more frequently recover than do those in which the appendages also are chronically inflamed.

Treatment.—Chronic inflammation of the prostate alone can usually be relieved by applications to the urethral and rectal surfaces of the organ and to the perinæum. A large (16 to 20 English) sound is introduced every two or three days, and permitted to remain three to five minutes; it should be used cold, or first quite hot and then withdrawn, quickly cooled and reintroduced.

Irrigation of the prostatic urethra with a quart or more of hot water (110° to 120° Fahr.), the bladder being emptied as required, is an effective

measure. Instillation of a few drops of silver nitrate, two to five per cent solution, is another.

The rectal surface of the prostate is mediated by suppositories, each containing one half grain of iodoform with cocaine or belladonna, and by hot rectal injections.

The perinæum is irritated by mustard or a blister, repeated at intervals of a few days for several weeks. Galvanism of the prostate has been advised, a current of ten to twenty milliamperes being passed for ten minutes from a negative pole in the prostatic urethra to a positive sponge on the perinæum. The general health should be most carefully maintained; the extreme despondency is better relieved by evident improvement in the local condition than by good advice, as usually recommended.

Some cases, particularly those in which chronic suppuration of the prostate exists, do not materially improve under these measures. In these I have had the best results by two additional procedures: careful stretching of the prostate by a special dilator, and parenchymatous injections from the perinæum. The stretching is used (in the absence of suppuration) where the characteristic perineal pain and sense of weight are prominent; it is followed by hot irrigation and instillation of silver-nitrate solution.

Parenchymatous injections are made from the perinæum with the ordinary hypodermic syringe provided with a strong needle three inches long; iodine-trichloride solution (1 part to 1,000 to 2,000 of distilled water) is the agent employed, ten to thirty minims being daily distributed in the gland during the gradual withdrawal of the needle.

When the chronic inflammation has involved the vas deferens and epididymis, a suspensory bandage is a valuable adjuvant.

Chronic Suppuration is a frequent feature of chronic inflammation of the genital canal, though the additional symptoms may be slight and pass unrecognized unless the pus reaches the surface. It occurs in the prostate, seminal vesicle, pelvic connective tissue, and epididymis. In the prostate the pus commonly empties spontaneously into the bladder or urethra; or it may, by causing retention of urine, lead to the introduction of a catheter, the pressure of this instrument bursting the abscess wall. Such abscess formation is not rare in cases of prostatic hypertrophy and of chronic prostatitis from gonorrhœa or stricture.

Chronic suppuration in the seminal vesicles (often associated with the same process in the prostate) may discharge into the urethra; or it may extend to the connective tissue between the bladder and rectum, producing a so-called "periprostatic"—properly speaking, pelvic—abscess. The pus may slowly burrow through the entire pelvic connective tissue even to the iliac crest, or it may remain long localized between the bladder

and rectum. The abscess ultimately points toward the rectum, bladder, perinæum, or suprapubic region. The suppurative process may proceed along the vas deferens and involve the epididymis, tunica vaginalis, and even the testicle.

These chronic suppurations due to subacute inflammation of the genital canal, and usually extending from the prostate, often remain undetected until they reach the surface or are revealed by autopsy. They are directly responsible for some cases of retention of urine, chronic cystitis, chronic urethral discharge, nocturnal emissions, vesical and rectal irritation and rectal fistula, suppurative epididymitis and orchitis. They can often be detected by careful digital examination, by rectal touch, and bimanual method.

A pelvic abscess, when discovered, should be opened not through the nearest surface, if that be a mucous membrane, but always through the skin. I have seen several chronic rectal and one urethro-rectal fistula result from the incision of an abscess in the recto-vesical septum from the rectum. Abscess in this locality can always be reached by incision from the perinæum, as already described; this route should be followed, even if the pus is found bulging the rectal wall into the lumen of the gut.

Tumors of the Prostate.—Tumors originating in the prostate are: 1, *Fibro-adenoma*, *fibro-myoma*, both included under the time-honored name "hypertrophy of the prostate"; 2, *Papilloma*; 3, *Cancer*; and, 4, *Cysts*.

HYPERTROPHY OF THE PROSTATE.

Prostatic hypertrophy is a disease of the second half of life; the period at which it commonly begins is undetermined, since it causes pronounced symptoms only indirectly, namely, by interference with the function of the bladder; hence it remains unnoticed until the occurrence of vesical disorder leads to its detection. This does not, as a rule, occur before the forty-fifth year of age, though individual cases have even required operative relief at an earlier age, and unique instances of prostatic hypertrophy have been observed at thirty-six, twenty-seven, and even five years of age.

The teaching of the older surgeons, that this morbid condition of the prostate is limited to advanced life, must therefore be interpreted as meaning that extreme interference with the exit of urine by the enlarged prostate does not commonly occur before the fiftieth year.

Some degree of enlargement is found in about thirty per cent of men who have passed this period; in many of these the vesical symptoms are slight, and are overlooked or misinterpreted. The cases of pronounced symptoms on the part of the bladder are probably not more than one in three or four of those affected with prostatic enlargement.

The etiology has not yet been determined.

Morbid Anatomy.—Prostatic hypertrophy consists in an overgrowth of all the normal elements—fibrous, muscular, and glandular—the first two predominating. Aside from the uniform enlargement thus produced, there is a characteristic feature in the tendency to arrangement of the fibrous and muscular elements into distinct nodules of spherical form, which can be shelled out from the cut surface even during life. The gradual growth of these tumors causes them to elevate, and finally protrude from those surfaces of the prostate which offer the least resistance—i. e., the vesical and urethral faces—for these are not hemmed in by firm fasciæ, as are the rectal and perineal boundaries. Hence a hypertrophied prostate rarely retains the original form of the gland; it presents a deformity as well as an enlargement, due to distinct tumors projecting toward or into the bladder and urethra. The greatest diversity in size, shape, and location of these outgrowths is observed; yet so commonly are they found at the floor and sides of the urethro-vesical orifice, that in this locality they were by the older surgeons considered integral parts of the enlarged glands, and were described under the names of middle and lateral “lobes,” respectively—terms still retained for convenience. They are found also in the body of the organ; projecting into the urethra; arching the urethral orifice like a collar or horseshoe; and even at times imbedded in the vesical wall, isolated from the prostate proper. In size they are found from the smallest noticeable dimensions to the bulk of an orange, the prostate and its outgrowth sometimes filling the true pelvis.

Pathology.—Whatever the form and location of these overgrowths, three morbid conditions are almost invariably induced:

1. Distortion of the prostatic urethra, which suffers a deviation in direction, decrease in caliber, often, also, elongation.
2. Elevation of the level at the vesico-urethral orifice; and—
3. Obstruction to the return of blood from the bladder, since the vesical veins empty into the compressed prostatic veins.

As a result of these anatomical changes various morbid symptoms ensue; decrease in the force of the urinary stream; imperfect evacuation of the bladder, a little “residual” urine remaining after each miction; slight catarrhal inflammation of the bladder; and a desire to urinate at intervals shorter than the normal period.

The last is the symptom which often first attracts the patient’s attention to his urinary organs. It is due in the early stage to irritation of the bladder-neck from venous congestion, for it occurs during the night (i. e., period of bodily inactivity), before it is manifest during the day (when muscular activity improves the circulation). It is also marked during overloading of the pelvic veins from constipation or overeating.

In the course of years further morbid conditions naturally ensue:

1. Dilatation of the bladder with increase of residual urine.

2. Hypertrophy of its muscular coat and fibrous tissue.
3. Depressions of mucous membrane ("diverticula") between the muscular trabeculae.
4. Dilatation of ureters and renal pelves, with stagnation of urine in them.
5. Congestion and catarrhal inflammation of entire urinary tract; accumulation of products in the bladder, tending to calculus formation.
6. Ammoniacal fermentation of urine, favored by but not dependent on the use of unclean catheters.
7. Septic inflammation extending from the bladder to the kidneys—"cysto-pyelonephritis" and chronic uræmia.
8. Death from uræmia, often provoked by various agencies, particularly the first use of the catheter.

Symptoms.—These vary, of course, with the extent of the disease. Among the earliest are difficulty in starting the flow of urine, feebleness of the stream, and unduly frequent calls to urinate, especially at night—"irritable bladder." In the earlier stages other symptoms may obscure the slight urinary disorder; the patient frequently complains that he is "bilious"—has indigestion, dryness of the mouth, loss of appetite, nausea, headache, and pain in the back, or slight fever—all of which may be due to mild uræmia. Another symptom is polyuria, even to six or eight pints daily, the urine showing reduced specific gravity, and sometimes a trace of albumin; such cases have been misnamed "diabetes insipidus."

With the advent of catarrh of the vesical neck the bladder symptoms become more prominent; frequent calls to urinate are felt by day as well as by night; the normal sense of satisfaction after micturition is lacking; the urine becomes cloudy and deposits a white sediment; dull pain may be felt along the urethra, in the perinæum and rectum.

The quantity of residual urine slowly increases, amounting sometimes to a quart or more; the overtaxed sphincter often yields to the pressure, permitting an involuntary escape of urine. This dribbling of urine indicates not "paralysis of the bladder," but an organ habitually distended in consequence of an impediment to the exit of urine. Thus far the patient may have been fairly comfortable, and the nature of his disorder unsuspected; but he may now be awakened to the gravity of his condition by the supervention of either of two events—a sudden and severe aggravation of the heretofore mild cystitis, or a complete retention of urine. Each is frequently provoked by chilling and wetting, particularly of the feet; excessive eating or drinking, constipation, undue physical effort. In either event the patient becomes usually the subject of chronic cystitis, which presents varying degrees of severity, now remaining mild for weeks or months, again increasing to an acuteness which confines him to bed.

Diagnosis.—A patient over forty years of age, whose history includes any or all of the symptoms narrated, may justly be suspected of prostatic hypertrophy; yet direct evidence should be elicited, since prostatic hypertrophy, like other frequent and familiar morbid states, is made to cover a multitude of sins in diagnosis—of omission as well as of commission; for the symptoms are primarily those of cystitis, which may be due to any one of many causes other than prostatic enlargement.

The examiner's oiled forefinger is gently insinuated into the patient's rectum, and notes carefully the size, smoothness, symmetry, and consistence of the prostate. Undue size or firmness of the organ (or both, for they usually coexist), furnishes proof that the prostatic disease may be responsible for the vesical trouble. Yet it is the urinary, not the rectal surface, which offers an impediment to the exit of urine, and there is no constant relation between the diffuse enlargement discoverable per rectum and those deformities of the organ which prevent the evacuation of the bladder; these are accessible only from the vesical side. A general idea of the conformation of the urinary side of the prostate may be sometimes obtained by the gentle manipulation of a sound, particularly when supplemented by a finger in the rectum. Yet this measure, to which much importance was formerly attached, is often disappointing.

The cystoscope sometimes enables the examiner to see distinctly the contour of the vesical surface of the prostate; but in many cases this instrument can not be introduced through the distorted and elongated prostatic urethra.

Yet the essential information sought is not the contour of the enlarged prostate, but whether or not the evacuation of the bladder is complete. This is ascertained by directing the patient to pass (in the upright posture) all his urine; a clean, soft catheter is then inserted; a flow of urine (which should be stopped at two ounces) proves that voluntary evacuation of the bladder is incomplete—that there is residual urine.

Having demonstrated prostatic enlargement and residual urine, the physician should not jump to the conclusion that he has made a complete diagnosis; for other serious morbid conditions may coexist, contribute largely to the patient's symptoms, and yet be obscured by the prostatic enlargement. The examiner must proceed to detect or exclude degeneration of the bladder walls, prostatic cancer and tuberculous, vesical calculus, tumor and tuberculosis, renal calculus and tuberculosis, and urethral stricture.

Degeneration of the Bladder Wall—sclerosis—is a not infrequent coincidence with prostatic hypertrophy, because both are frequent features of the second half of life. The French school, indeed, following Civiale and Guyon, regards the prostatic disease as merely one manifestation of general senile sclerosis involving arteries, kidneys, and bladder. While

this conception seems entirely refuted by clinical and anatomical observations, yet the frequent coincidence of prostatic enlargement and general sclerosis in elderly subjects should be remembered; since degeneration of the vesical wall may be a potent factor in the retention cystitis of prostatitis.

Cancer of the prostate, when advanced, is recognized by the uneven hardness and nodular projections perceptible per rectum, the infection of inguinal glands, emaciation of the patient, hæmaturia and prostatic pain, microscopic and cystoscopic appearances. In the earlier stages the disease is doubtless often undetected because passed as simple prostatic hypertrophy. The writer made this mistake a few years ago in a case which a year later showed the typical features of cancer—a diagnosis subsequently confirmed by autopsy.

Tuberculosis of the prostate is recognized by the nodular rectal surface, thickening of the seminal vesicles, epididymis, etc. It may coexist with prostatic hypertrophy and be overlooked in consequence. The writer once made a perineal prostatotomy, and discovered only when the finger entered the prostatic urethra that there was a tuberculosis of the prostate; subsequent observations proved that the pronounced general hypertrophy was the minor factor in the production of vesical irritability in this case.

Vesical Calculus is the natural and frequent sequence of retention cystitis from prostatic hypertrophy. Its detection by the sound or cystoscope should follow, though notoriously difficult because of the frequent concealment of the stone in the various pockets which abound in such bladders.

Urethral Stricture is a possibility that should not be ignored.

Renal Calculus and Tuberculosis may induce the symptoms of cystitis, and be overlooked in the presence of the more evident prostatic hypertrophy.

Having determined by exclusion of these possibilities that prostatic enlargement is alone responsible for the urinary symptoms in a given case, the physician should then thoroughly and invariably examine the patient; therapy and prognosis are based upon the general condition rather than that of the prostate. The points to be especially investigated are the upper urinary tract, the arteries, and the general nutrition.

The condition of the kidneys can not always be ascertained with certainty; renal sclerosis may exist though no casts be found, the latter being dissolved by alkaline urine. The quantity of urine in twenty-four hours, its specific gravity, and the relation of albumin present to the quantity of pus, should be ascertained. Polyuria or low specific gravity—with or without renal albuminuria—suggests involvement of the kidney

either as sclerosis or as pyelonephritis, and therefore demands caution in both prognosis and treatment.

Arterio-sclerosis, indicated by hard and tortuous arteries, polyuria, possibly cardiac hypertrophy, is a most serious coincidence; for the subjects of this disease are poor material for therapeutics, whether medical or surgical.

The patient's general condition, weight, flesh, color, vigor, dryness of skin, digestion, excretion, his occupation and habits, are factors about which full information should be secured.

Prognosis.—Prostatic hypertrophy involves peril to life only indirectly, through disorganization of the urinary apparatus. While restoration of the bladder function can not be expected, except through surgical interference, yet the catheter function, so to speak, may be successfully and comfortably substituted for an indefinite time—ten, fifteen, or more years. The course of events varies extremely, and is influenced by many conditions other than the prostatic hypertrophy.

Treatment.—The first object of rational treatment would naturally be the removal of the prostatic obstacle to urination and restoration of the normal relations at the bladder-neck. All efforts to this end (other than surgical, to which a special chapter will be devoted)—internal medication, parenchymatous injections, galvanism—have failed. Treatment must therefore be palliative, aiming alike to retard the destructive changes in the urinary tract, and to secure the patient from the discomforts incident to the urinary impediment.

He should be instructed in personal hygiene; assimilation and excretion should be promoted. Good digestion, daily and easy defecation, warm baths, and friction for the skin, warm clothing, plenty of food, sunlight, air, and exercise, are cardinal principles for the prostatic. He should drink at least three pints of good water daily (hot, if preferred), and plenty of milk, unless specially contraindicated. He should be warned that the process commonly termed “taking cold,” exposure to inclement weather, excess in eating and alcohol drinking, extreme bodily effort, and habitual constipation, have a special and immediate danger for him, in that acute cystitis and complete retention of urine are commonly provoked by one of these.

Local Treatment varies in its details with the degree of urinary derangement. The cardinal principles are always—

1. To retard the progressive distortion of the prostatic urethra.
 2. To promote complete evacuation of the bladder—i. e., prevent the accumulation of residual urine.
 3. To prevent or arrest septic processes in the urinary organs.
1. Efforts to retard the progress of the prostatic distortion are perhaps never entirely successful; yet, in the earlier stages especially, they should not be neglected.

The plan followed in gradual dilatation of urethral stricture should be applied to the prostatic urethra; the passage of steel sounds every four to six days, beginning with the largest that enters easily, and increasing the caliber until the full size (18 to 22 of the English scale) has been introduced. More complete stretching of the prostate can be secured by the judicious use of special dilators. The writer has been convinced by experience of the value of this neglected measure in facilitating the exit of urine.

2. To prevent the accumulation of residual urine the catheter is the chief reliance. The patient should be at once taught to pass the instrument, and the necessity for its daily use explained. Because some of the older surgeons advised that catheterism be deferred as long as possible, it must be expressly stated now that the detection of residual urine renders the daily use of the catheter imperative, even though the patient urinates voluntarily and with apparent freedom. In cases where the bladder is habitually distended with residual urine, the evacuation must be gradual and cautious, as will be presently explained; but in any case, after the bladder has been completely emptied by the physician, the patient must keep it empty, supplementing Nature's effort by the use of the catheter one or more times daily as may be required.

Catheters, it is understood, should be *flexible* and *clean*. The soft Nélaton catheter (velvet eye preferred) will usually enter the bladder; if it fail, the stiffer *coudé* instrument of Mereier, commonly called prostatic catheter, generally succeeds. Metallic instruments, and those armed with a stylet, can easily be made to lacerate the urethra, and are rarely needed except in cases of extreme hypertrophy.

All instruments used should be surgically clean—aseptic. The soft as well as the metal catheters can be sterilized in the usual way, by boiling. Elastic instruments are destroyed by hot water, and must be rendered aseptic by thorough mechanical cleansing and prolonged immersion in five-per-cent carbolic or similar solution. For lubrication, a five-per-cent borax solution in glycerin has evident advantages over the usual dirty oils; in it, moreover, catheters can be kept clean when not in use.

It is never amiss to warn the patient that flexible catheters are prone, when given the opportunity, to disappear into the urethra. When one is inserted, the outer end should be constantly held. He should also be advised to discard a catheter whenever its surface shows cracks or its eye becomes rough.

3. To combat septic inflammation in the bladder many means have been recommended; only the following need consideration: Hot water, boroglyceride, nitrate of silver, bichloride of mercury, and trichloride of iodine.

From the earliest stage the patient is instructed to bathe the bladder

daily with water as hot as can be comfortably borne, say from 98° to 108° Fahr. A few ounces—not enough to provoke a feeling of distention—should be gently injected, the eye of the catheter being first withdrawn into the prostatic urethra, so that the latter as well as the bladder is washed. (Many prostaties can inject the bladder direct from the meatus without a catheter.)

So long as the urine remains acid, an excellent local application is boroglyceride, a teaspoonful to a quart of warm water. After two or three washings with plain water the boroglyceride solution is injected, allowed to remain a few minutes, and withdrawn.

Should decided irritation of the bladder-neck occur, as indicated by frequent desire to urinate with pain along the urethra, the bladder washing may be followed by a deep urethral injection of silver nitrate, one quarter to one half grain to the ounce of water; or three grains of cocaine muriate in a drachm of water may be instilled into the deep urethra, or both may be profitably used.

When the urine has become ammoniacal, the washing of the bladder with hot water must be very thorough, and followed by a solution either of mercury bichloride (1 to 10,000, 15,000, or 20,000) or of iodine trichloride (1 to 2,000). The latter has in my hands superseded the former. It is important that the prostatic urethra as well as the bladder receive these applications—that is, the catheter should be withdrawn until the eye has receded one to two inches from the bladder. The fluid then injected enters the prostatic urethra, and passes through this canal into the bladder; the catheter is then pushed back until the outward flow is re-established. Should the catheter have been withdrawn too far, notice is given, so soon as the injection commences, by the appearance of the injected fluid around the catheter at the meatus. Washing of the prostatic urethra in this way should always be included in the washing of the bladder; in these pages the latter phrase is meant to designate both.

The method of evacuating the bladder during irrigation is also a matter for consideration. As ordinarily done it is quite inefficient, because left to the unaided expulsive effort of the bladder. Now it is admitted that this organ in the prostatic, when it has reached the stage under discussion, does not and can not expel all its contents; the heavier pus and mucus particularly gravitate to the base below the urethral orifice and behind the protruding prostate, whence expulsion by the natural effort is most difficult and least probable. Moreover, such a bladder usually presents diverticula of the mucous membrane between the muscular fibers, which pockets are distended rather than collapsed by vesical contraction, and are consequently reservoirs for stagnant urine, pus, mucus, and blood. The emptying of the bladder should therefore be assisted by two simple measures: (1) the position of the patient, who turns as much as possible on his

breast, the hips somewhat elevated, or take the "knee-elbow" position; and (2) the suction of a siphon, easily secured by disconnecting the tube from the fountain syringe (the best instrument for irrigation) and conducting it to a basin of water on the floor.

When the cystitis becomes very acute and painful the bladder may be rested by continuous drainage for a few days through a soft catheter, the instrument being retained in position by a rubber "catheter-holder"; in its absence, a good substitute can be made with a strip of dentist's rubber-dam five or six inches long, perforated in the center to slip over the end of the catheter against a safety-pin near the meatus; the ends of the strip are applied to the sides of the penis and retained by adhesive plaster strips, which should not entirely encircle the penis. Twice daily the catheter should be removed and cleansed, and the anterior urethra irrigated, to diminish the urethritis and irritation which usually ensue. This drainage of the organ through a catheter (with or without the siphon attachment) is an efficient and simple means of relief during aggravations of the cystitis. A patient whom I saw with Dr. Seelye, of Chicago, became so enamored with the method that he wore the catheter continuously for two years, meanwhile performing his duties as a mechanic; his act of urination consisted simply in withdrawing a plug from the end of the instrument.

In some cases catheter drainage fails to relieve the cystitis, and in others the constant contact of the catheter can not be endured; these should be promptly relieved by puncture of the bladder through the prostate from the perinæum, the cannula, guided by a finger in the rectum, being made to enter the post-prostatic pouch. A soft catheter is introduced through the cannula, which is then withdrawn; the catheter can be retained indefinitely by adhesive plaster. This simple operation can be practiced without anæsthesia.

Attempts to improve the condition of the urine by internal medication have not, in the writer's observation, been attended by pronounced success; yet there can be no objection to the proper use of the various demulcents and diluents, from slippery-elm and buchu to corn-silk and pichi. An emulsion containing small doses of powdered cubebs, turpentine, and belladonna is worthy of trial. For arresting fermentation in the urinary cavities, salol, boric acid, saccharine, and microcidine have each been highly lauded. Perhaps the most efficient means is a combination of borax, boric and benzoic acids, three grains each, taken four to eight times daily. As the digestive organs of the prostatic are, as a rule, easily deranged, over-medication must be avoided.

Such is, in brief, the palliative treatment by which most subjects of prostatic hypertrophy are enabled to pass many years in comparative comfort and safety. They are, of course, liable to sudden exacerbations

of cystitis and sudden œdemas of the prostate, troubles which generally subside under rest in bed combined with the treatment already outlined.

Complications.—Yet deviations from this general course are by no means infrequent—conditions fraught with suffering and danger to the patient, and commonly requiring interference by the surgeon; they may be thus enumerated:

1. Complete retention.
2. Interference with defecation by the prostatic tumor.
3. Persistent cystitis of great severity.
4. Such distortion or stenosis of the prostatic urethra as renders catheterism extremely difficult or painful.

Complete Retention.—Many prostaties seek no medical advice until, after chilling, excesses in eating and drinking, or other cause, they suddenly find themselves unable to void any urine. Rest and a hot bath often re-establish the flow, but frequently all domestic remedies fail.

This is an epoch fraught with danger to the patient and responsibility to the physician. Many a prostatic experiences serious, even fatal illness after such a crisis, because the physician sees in acute retention no indication except to empty the bladder as soon as possible.

When called to such a case, the physician should observe three rules of vital importance:

1. Never use force, nor lacerate the urethra with the catheter; in other words, use flexible instruments.
2. Observe strict aseptic precautions as to instruments, etc.
3. Never empty the bladder completely at one sitting.

The patient's entire urinary tract above the prostate is probably in a state of chronic inflammation and overdistention with urine; there are therefore three calamities that may be directly and immediately provoked by the catheter: 1. An unclean instrument may start a septic inflammation of the entire urinary tract—cystitis, pyelitis, nephritis, one or all. 2. Lacerations of the urethra—"false passages"—not only increase greatly the difficulties in reaching the bladder, but also offer an opportunity for acute urinary intoxication and infiltration. 3. The immediate evacuation of the bladder, even with antiseptic precautions, causes a collapse of the distended urinary tract and consequent engorgement of its surface. Within a few days the urine contains a little blood (independent of mechanical injury), becomes turbid and scanty; the temperature rises, the tongue becomes dry and brown, the mind a little unsettled—in short, the patient sinks into the condition known as the typhoid state. The term "catheter or urinary fever" has been promiscuously applied to these morbid states, which are, however, essentially distinct; the cause of the fever being in the first case a septic infection of the urinary tract, in the second an intoxication from urinary absorption, in the last uræmia from

congestion of the kidneys caused by sudden removal of the habitual pressure of the retained urine—a “hyperæmia ex vacuo,” as it has been termed. Doubtless two or all of these may be induced in the same patient by attempts to relieve complete retention.

The patient suffering from complete retention should have the rectum emptied by a hot-water injection, to be followed by a suppository containing one-eighth grain of morphine, or an enema of thirty grains of chloral in a half pint of warm water. A hot sitz-bath, or, in lieu of this, hot-water fomentations should be employed for twenty or thirty minutes. The effect of these measures is often to cause the escape of some urine; even if this occur, catheterism is still necessary. The patient is warmly covered in bed, the hips elevated above the shoulders. The anterior urethra is irrigated with hot water and injected with warm, clean oil; a clean, soft catheter (No. 10 or 12 English) is filled with the oil and introduced, the penis being drawn firmly forward. Steady, persistent pressure on the instrument—slight as the transmitted force necessarily is—is often rewarded by a gush of urine. Should this effort fail, an elastic *coudé* catheter of smaller size is next tried; flexible instruments of various sizes and shapes may be afterward employed. In most cases one of them enters the bladder.

In exceptional instances, all flexible instruments having been arrested before reaching the bladder, rigid catheters may be used. The metal or stylet-armed instrument selected should be of good size (14 English, or larger), of very long curve and clean. In the attempt to introduce it *force must be scrupulously avoided*, for no one can know the direction of the distorted and swollen prostatic urethra. The catheter is guided less by anatomical knowledge than by the resistance it encounters, and the attempt to force the rigid instrument results usually in sinking its point into or beyond the urethral wall. False passages are made, blood flows freely, and the difficulties of the situation are multiplied. The physician, naturally disliking to acknowledge himself baffled, yields to the temptation to employ more force, until finally the prostate is perforated with holes.

While prostatic retention, until maltreated with instruments, is usually relieved with ease, yet after false passages have been made it is sometimes impossible for even a skillful hand to find the natural way to the bladder with any catheter. In this case suprapubic aspiration should be made, the needle entering at right angles with the spine, about an inch above the upper border of the symphysis. A half or a third of the estimated contents of the bladder is withdrawn, hot fomentations again applied, and the patient left in bed for some hours. The relief of bladder tension and reduction of prostatic œdema by this time often results in easy catheterism or even voluntary urination. Should retention persist

for a day or two, aspiration must be superseded by some one of the methods of operative relief to be presently described.

Should the physician succeed in introducing the catheter, he must not evacuate the bladder completely at the first sitting; about a third of the estimated quantity, say from six to ten ounces; may be withdrawn and two or three ounces of some antiseptic solution injected. Five or six hours later a larger quantity may be withdrawn, and thus in the course of two to four days the bladder may be gradually emptied. If the first introduction is extremely difficult, the catheter may be left in place for a day or two, tightly corked, until complete evacuation is secured.

Even with the greatest care some fever frequently follows complete retention, requiring the first use of the catheter; yet the illness is kept at a minimum by the measure described.

Persistent cystitis of high grade, difficult catheterism from prostatic distortion, and rectal impediment from prostatic tumor, should be relieved by operative treatment.

OPERATIVE TREATMENT OF PROSTATIC ENLARGEMENT.

In a considerable number of prostatitis the palliative measures already enumerated fail to avert constant suffering and a fatal result. These cases were formerly regarded as beyond surgical aid; aside from the relief obtained by suprapubic puncture, they were abandoned as hopeless.

During the last decade temporary drainage of the bladder by different routes has become a standard operation for the relief of these patients. Yet this measure, though gratifying in its immediate results, is in theory unsatisfactory, and in practice but too often of only temporary benefit. The relief so obtained is of uncertain tenure; the factors which originally induced the malady remain undisturbed; they may, and as experience shows they often do, cause a recurrence of the vesical inflammation and difficulties of catheterism.

A rational procedure should aim to give permanent relief by removing the cause of the urinary difficulty. This has been attempted upon two plans:

1. The institution of a permanent artificial exit for the urine—a ventral or perineal fistula—whereby the obstructing prostate is avoided.
2. The restoration of the natural urinary channel through the prostate—a so-called radical operation, or “prostatectomy.”

The former is evidently the simpler method. The suprapubic fistula has been often made in the past half century, usually by puncture with a trocar, sometimes by cystotomy, a tube being more or less constantly worn subsequently. A perineal fistula, kept open by a soft catheter passing through the incision and the prostatic urethra, has also been found useful.

The permanent fistula is a mutilation obviously to be employed only when the restoration of the urethral channel seems impracticable. Aside from the objections on the score of sentiment and comfort, the fistula can not be relied upon to secure immunity from cystitis; thus, Bennett May mentions three instances of such failure in his own practice. The explanation of the failure is, perhaps, that the projecting portions of the prostate prevent complete evacuation of the vesical contents; and probably that these tumors, like other neoplasms and foreign bodies, induce mechanical irritation of the bladder. The latter condition seems to have been exemplified in one of May's cases, which, after the fistula had failed to give relief, was entirely cured by the removal of a large middle lobe.

The theory of the radical operation assumes that the cause of chronic retention is mechanical obstruction by the enlarged prostate; that such prostatic obstacles are capable of removal; and that after such removal the bladder will resume its function of voluntary evacuation.

These propositions have been separately and collectively denied by three of the foremost among living genito-urinary surgeons—Thompson, Guyon, and Socin. Guyon maintains that prostatic enlargement is but a local manifestation of a general senile "sclerosis" which pervades the entire urinary tract; that the chronic retention is chiefly due not to prostatic obstruction but to the coincident impairment of vesical contractility caused by sclerosis of the bladder muscles; hence, that the removal of prostatic obstacles is irrational, and futile to restore voluntary urination. He asserts further, as the result of post-mortem examination, that the prostatic obstacle is rarely of such contour as to permit its removal by the surgeon. Socin advances essentially the same opinions. Thompson, while repudiating sclerosis as the cause, and assuming that enlargement of the prostate is an attribute of senility, indorses Guyon's conclusions.

These are, however, conjectures unsupported by clinical experience. Thompson and Socin have not yet performed—or at least have not published—a single radical operation. Guyon made his first attempt in July, 1889, and found a prostatic growth readily removed.

The accumulated clinical observations of the past five years prove that these traditions of the earlier surgeons, upheld by Guyon and Thompson—which have dominated surgical opinion and practice—must be restricted to a minority only of prostaties; for it is clearly demonstrated:

1. That there is a larger class, entirely distinct from these, in whom the failure to evacuate the bladder is due in no wise to degeneration of the vesical muscles, but solely to the mechanical obstruction offered by prostatic growths; since the removal of such obstacles has been followed in over three fourths of the cases previously dependent upon the catheter by restoration of the vesical functions.

2. It is shown that the enlargement of the prostate, commonly called "senile" hypertrophy, is not limited to advanced life. Thompson has strenuously taught that "it never appears but in advanced years," the minimum age being fifty-six. "I have never been able to meet with an instance of its occurrence at so early a period as fifty-three years of age." Many others have seen it in younger men. McGill removed a prostatic collar, "the size of a large walnut," from a man aged fifty-three; M. Schmidt, a large middle lobe from a man of fifty-two; the writer has removed a prostatic growth from a patient aged forty-nine; Packard operated a case forty-three years old; Moullin one at forty-one; Dunn excised a tumor of the lateral lobe from a man of forty-five; Iversen described a case at thirty-six years; H. G. Mudd exhibited to the Association of Genito-Urinary Surgeons, 1890, an extreme example of prostatic hypertrophy from a negro aged twenty-seven; the prostate and its outgrowths literally filled the true pelvis, and on microscopical examination were found to be fibro-myomatous, without a suspicion of malignancy. On the same occasion Dr. Mudd mentioned a case of true prostatic hypertrophy, under the observation of Dr. H. H. Mudd and himself, in a child of five years.

3. That the prostatic obstruction is usually—contrary to the opinions of Guyon and Thompson—of such form as to permit excision, is shown by the fact that in four fifths of the cases of suprapubic incision such obstacles were found and removed.

The assumptions upon which the radical operation is based are therefore justified by experience. It is proved that in many prostatics the source of the evil is to be sought not in sclerosis or senile degeneration of the bladder, but in mechanical obstruction by prostatic tumors; that these tumors are not a product of sclerosis, nor of senility, nor even limited to advanced life; their greater frequency after forty years of age is paralleled by that of other tumors, particularly the fibro-myomata of the homologous organ, the uterus, which are not considered an attribute of senility; that these tumors are in most instances susceptible to removal; and that in such cases a well-executed radical operation restores voluntary urination.

It is indisputable, however, that in many prostatics of advanced age arterio-sclerosis and degeneration of the vesical walls coexist; the contractility of the bladder is seriously impaired, and removal of the prostatic obstruction fails to restore voluntary evacuation of the organ. In nearly one fourth of the cases on record the radical operation failed to restore voluntary urination; while in several it is evident that the removal of the obstacle was incomplete, yet in others the explanation of failure seems to have been impaired vesical contractility.

Differentiation between the obstructive and degenerative factors in a

given case should naturally precede operative measures; at present such differential diagnosis can not always be accurate. The subject of pronounced sclerosis exhibits rigid arteries—polyuria; his prostate is very hard, his bladder not dilatable. In the presence of these symptoms restoration of voluntary micturition can not be expected; the radical operation is useless except to facilitate difficult catheterism.

Modes of Operation.—Prostatic obstacles to urination have been attacked by four routes:

1. The urethra (Mercier, Bottini).
2. Perineal incisions (Harrison, Keyes, Dittel).
3. Suprapubic cystotomy (Belfield, McGill).
4. Combined perineal and suprapubic incisions (Belfield).

The operation should secure three results: Restoration of a low-level urethra by removal of prostatic obstacles; temporary drainage of the bladder; and stretching of the prostatic urethra. The choice of operation is therefore a mechanical problem, determined largely by the accessibility of the prostatic obstruction. Now, these present the greatest diversity in size, shape, and location. Whether the obstruction is a distinct tumor, median or lateral, sessile or pedicled, intravesical or intra-urethral; or a so-called bar; or a combination of these—can be in only exceptional cases more than conjectured by any means other than digital contact, which is, therefore, the first essential of every accurate radical procedure.

This condition obviously excludes from serious consideration all operations from the meatus, and shows the limitations of operations through any perineal incision, since the average finger is too short to explore or even to reach the vesical orifice from the perinæum when the prostate is much enlarged. Operations from the meatus are evidently, in the light of present experience, tentative, haphazard procedures; they were based upon the faulty conception that the prostatic obstacle is always a bar or other median obstruction; and that the division of this supposed bar would effect relief. These operations of Mercier secure no one of the three essentials sought; they contain, moreover, elements of danger foreign to the later procedures, where the cutting edge in the bladder is directed and controlled by digital contact. His followers have been few, and his operations seem now to possess only historic interest. Bottini's modification of Mercier's operation—the substitution of a cauterizing for a cutting edge—is equally unsatisfactory, and seems to have found no adoption.

Perineal urethrotomy has been employed in some forty cases as the avenue of access to the prostatic obstacle; small median tumors (middle lobes), transverse overgrowths (bars at the bladder-neck), have been incised and excised; even lateral masses of considerable size have been

enucleated (Wishard). Yet many cases are not capable of satisfactory treatment by this incision; the elongation and rigidity of the prostatic urethra prevent complete operation or even exploration at the bladder-neck. The surgeon may therefore fail to detect the obstructing portion, or find its removal impracticable. Since it is impossible to distinguish in advance the cases operable by this incision, it is apparent that a better method, one that shall be applicable to every case, is required.

Suprapubic cystotomy seemed at first to fulfill every requirement; it secures minute exploration of the entire vesical surface of the prostate, the easy recognition and complete removal of the intravesical projections, and thorough drainage of the bladder. Prostatectomy by this incision has been performed over eighty times with satisfaction to the operator, and often with results most gratifying to the patient. Yet in several instances this operation has failed to detect or to remove the prostatic obstruction; failures which direct attention to the fact—rather obscured by the many brilliant successes in removing intravesical growths—that the object is *to restore a low-level channel through the prostate*, and not simply the excision of salient tumors. To this end *exploration of the urethral is quite as important as that of the vesical surface* of the prostate; for the canal may be distorted by growths imperceptible or inaccessible from the bladder; especially frequent is a pronounced thickening of the suburethral prostate, whereby the urethra is elongated and the vesical orifice displaced upward. In five recorded cases such a mass has baffled the surgeon who approached it by suprapubic incision; in two (McGill) it could not be satisfactorily removed; in a third (Guyon) the partial removal was insufficient to restore the channel; in the remaining two this obstruction was overcome by perineal incision and stretching (M. Schmidt, Belfield).

By suprapubic incision alone the surgeon may find himself unable to restore the patency of the urethral channel; the intravesical projections may in a given case constitute but a part of the prostatic obstruction, and the removal of such outgrowth is not necessarily a successful operation. The prostatic urethra should always be explored by the finger; and the usual discovery of a hard, suburethral mass or rigid ring should be the signal for perineal urethrotomy, incision or excision of the resisting tissue, and thorough stretching.

It seems, therefore, that the combined operation by both suprapubic and perineal incisions should be the rule rather than the exception; the addition of the *bouttonnière* increases but slightly the injury to tissue and the time of anaesthesia, while it affords an access to the entire prostate, which may convert an utter failure into a complete success.

Results.—The results of the various radical operations have been carefully collected and discussed by Watson in an excellent monograph

published in 1888 ; by the present writer in the *American Journal of the Medical Sciences*, 1890 ; and by Mansell Moullin in his admirable *Hunterian Lectures* for 1892. In all, about one hundred and fifty cases are now on record ; while pioneer results, performed by many surgeons acquiring experience with any operation, naturally failed to exhibit the full value of the measure, yet even these early experiments show the value and success of radical operations in relieving a hitherto incurable and most distressing condition. In about three fourths of the cases voluntary urination has been restored in patients previously dependent upon the catheter ; in most of the remainder catheterism has been made easy.

The mortality of prostatectomy (thirteen per cent) seems somewhat greater than that of cystotomy in elderly men for other purposes, particularly the removal of calculi, though due to the same causes—uræmia, shock, and irritation of the respiratory tract by the anæsthetic. In other words, the hazard of the operation is entirely due to the pre-existing disease of the urinary tract as well as to the enfeeblement of vitality from age and protracted suffering ; and its excess of mortality over lithotomy must be ascribed to the greater delay in operating. In only one case was serious local disturbance caused.

The obvious deduction is, that the operation should be performed earlier in the course of the disease, and not, as heretofore, deferred until the last stage. Corroboration of this inference is found in the paradox that operations upon the prostate complicated with calculus extraction furnished a much smaller mortality than the uncomplicated prostatectomies. A calculus was therefore an advantage rather than an injury, since its presence led to early operation.

Opportunity is still lacking—because the operation is so recent—to determine decisively whether the restoration of voluntary urination is permanently assured ; further experience must show whether new tumors may not frequently develop from the unexcised prostate, causing a recurrence of the original morbid condition. Actual observation on this point is limited as follows : (1) In twenty-four cases, unobstructed urination and catheterism have persisted for periods ranging from six to thirty-two months after removal of prostatic obstacles ; (2) in two cases, actual inspection of the bladder three months after operation showed no further tumor formation.

On the other hand, Schmidt observed at an autopsy, nine months after the removal of a median enlargement, that a new growth had appeared near the site of the one removed. The description suggests a malignant tumor rather than a prostatic myoma, but no microscopical examination is recorded. An important deduction from these considerations is the indication for thorough enucleation of all circumscribed masses within as well as above the general prostatic surface. Such tumors can

be enucleated after incision of the mucous membrane with surprising facility. McGill especially has demonstrated the feasibility of this measure in many cases of his extensive experience. Vignard, experimenting upon the cadaver, corroborates this observation; he asserts that in six out of ten cases he has enucleated the entire prostate—hypertrophied or otherwise—with reasonable ease.

This process of enucleation obviates the necessity for the operation suggested by Dittel, under the title of “lateral prostatectomy.” After emphasizing the importance of the neglected lateral lobes in the production of retention, and criticising Harrison’s plan of treating them by prolonged pressure as inefficient, Dittel shows that they can be reached by separation of the rectum from the prostate; and by operation upon a cadaver with lateral enlargement of the prostate, he proved that the excision of portions of the lateral lobes from the rear—without opening the bladder—relieved the prostatic obstruction by permitting the vesical surfaces of these lobes to fall apart. He admits that suprapubic cystotomy would also often be necessary for the removal of intravesical obstacles; and that the two operations, even if separated by an interval of weeks, would rarely be sustained by the same subject until patients are educated to submitting to them at an early stage of prostatic disease.

Dittel makes no allusion to the fact that the lateral lobes can be and have repeatedly been removed by enucleation after suprapubic cystotomy. The ingenious operation suggested by Dittel seems therefore to have been anticipated by a much simpler, safer, and more practicable means of attaining the same end.

Küster has, however, performed the operation on three patients, with a fair degree of relief to the bladder symptoms, though in two of them a permanent urinary fistula resulted.

Operation.—The salient points in prostatectomy may be thus enumerated:

When time is allowed, the patient may be for two weeks previously prepared by restriction to a diet of milk and vegetables, with copious ingestion of water. Antisepsis of the urinary passages may be attempted by the internal and local remedies already described. Chloroform is preferable to ether for anæsthesia, because less irritating to both kidneys and lungs.

During the operation the body is inclined so that the hips rest six to eight inches higher than the shoulders; the bladder is moderately distended (eight to ten ounces); the rectal bag is both unnecessary and dangerous; aside from mechanical injury (bruising, even rupture of the rectum), the distention may cause alarming decrease of the blood-pressure. This depression of the circulation by rectal irritation, first observed by the writer in experiments on animals (Du Bois-Reymond’s *Archiv für*

Physiologie, 1882), was subsequently witnessed in two of his patients, in marked degree, while a rectal bag was being filled in preparation for suprapubic cystotomy. Wishard has since observed three similar cases, one of which did not rally.

After suprapubic incision, further procedures are determined by the size and location of the growths. Pedicled tumors, such as middle lobes, are removed by cautery wire, snare, tonsillotome, or scissors (bleeding may be profuse when edged tools are used); sessile tumors, such as lateral lobes, can usually be enucleated with the finger or spoon, after the mucous membrane is incised. Protruding parts of the prostate that can be neither excised nor enucleated safely should be treated by sinking a cautery point into them—a measure which induces subsequent absorption.

After treatment of intravesical projections, the vesical orifice and prostatic urethra are examined with the finger. Usually a suburethral growth is found; a perineal urethrotomy is then made, one forefinger inserted through the incision and the other through the vesical orifice until they meet; obstructions detected are removed according to indications, since the object of the operation is to restore a low-level, unobstructed channel from the bladder to the membranous urethra. The suprapubic wound may often be closed, except for drainage of the prevesical space, and the bladder drained by a large perineal tube extending at least an inch into the vesical cavity.

The dangers of prostatectomy are :

1. Hæmorrhage.
2. Intoxication and sepsis from contact of fetid urine with prevesical tissue.
3. Uræmia.

Hæmorrhage is minimized by the substitution of the cautery for the cutting edge, and may be checked by packing with iodoform gauze.

Intoxication and infection from urine are combated by prior cleansing of the urinary passages by iodoform and drainage. This great risk is, however, best reduced by making the operation in two stages: at the first, merely exposing the bladder and packing the wound with iodoform gauze until granulation is established (five to seven days); then opening the bladder and completing the operation.

Uræmia, due to existing pyelonephritis or renal sclerosis, is a frequent cause of death; nervous shock and the anæsthetic seem to be exciting causes. Hence chloroform should be used as sparingly as possible.

Palliative Operations—While the radical operation for prostatic hypertrophy gives great satisfaction to both patient and surgeon, its utility is as yet restricted by the fact that many patients requiring it are, when they reach the surgeon, too feeble to endure it without great risk.

Education of both physicians and patients to the necessity for earlier

interference, will in time extend the usefulness of this life-saving operation; meanwhile help in some form must be extended to the large class who can no longer obtain relief through the catheter, and yet must not be submitted to prostatectomy.

For such, great relief at far less risk is afforded by drainage of the bladder through a suprapubic or perineal opening, which can be maintained as a permanent fistula if desired. (The ventral opening is preferred as a permanent exit, because more easily endured and managed by the patient.) If anæsthesia be permissible, a suprapubic cystotomy or perineal urethrotomy is made for the insertion of a soft-rubber tube; if anæsthesia be deemed unsafe, the opening can be made with a trocar, plunged above the symphysis, or from the perinæum through the prostate.

As a rule, great comfort is immediately derived from any of these methods of draining the bladder; the cystitis and prostatic œdema subside; sometimes spontaneous urination or easy catheterism follows in a few weeks; the tube is withdrawn, and the patient enjoys comparative comfort for many months.

But when the bladder is small and undilatable or catheterism very difficult, such lasting benefit can not be expected from temporary drainage; the fistula must usually be made permanent. While the patient greatly prefers this mutilation and comfort to his former suffering, yet the evident annoyances are many and constant. In the hope of diminishing these, I have devised a plan which, in the only case as yet so treated, succeeded perfectly, and which seems worthy of repetition, especially in cases of difficult catheterism too feeble for a radical operation. A staff with broad groove is introduced until its point rests in the prostatic urethra; a trocar slightly curved, the convexity of its cannula being open, is plunged into the perinæum (mesial line) about an inch and a half above the anus, its point, guided by the finger in the rectum, is made to enter the groove of the staff at the apex of the prostate, it is pushed through the substance of this gland nearly horizontally (the patient lying on his back) into the bladder. The trocar is withdrawn from the cannula, the staff from the urethra. An elastic catheter armed with a straight stylet is passed through the urethra into the cannula and thence to the bladder. The cannula is then withdrawn, its track serving the important purpose of drainage, to prevent urinary infiltration.

This low-level channel through the prostate seems to have the advantages of the usual external fistula, without the annoyance common to the latter from constant dribbling of urine (prevented by the sphincter action of the membranous urethra). When necessary, the bladder can be kept empty by tying in a catheter. That such a channel, made by bungling and forcible catheterism, can even form a good substitute for the radical operation, has been occasionally revealed on the post-mortem table.

SUMMARY.—I. The prostatic suffering from persistent severe cystitis, or difficulty or pain in catheterism, should early receive operative relief; delay is destructive to his urinary apparatus and hence to his chance for life and comfort.

II. The choice of operation must be determined partly by the patient's vigor and partly by the condition of the bladder: fair health, renal integrity, a distensible and contractile bladder, warrant the radical operation; debility, renal disease, a small, undilatable bladder, restrict the operative interference to drainage, temporary or permanent.

III. The safest and simplest method of drainage is puncture from the perinæum through the prostate, with little or no anæsthesia. This may be profitably performed in any of these cases, even if more radical measures are subsequently undertaken.

IV. Between these extremes—the radical operation and perineal puncture—are several measures of intermediate gravity, one of which may be selected according to the vitality and needs of the patient:

1. Perineal prostatotomy after Harrison—i. e., urethrotomy, incision of the urethral floor at the vesical orifice, drainage for six to twelve weeks through a large tube. (A distinct middle lobe would naturally be removed when easily accessible.)

2. Perineal urethrotomy or suprapubic cystotomy for drainage, temporary or permanent.

HYPERTROPHY OF THE PROSTATIC SPHINCTER.

By this tentative term I have designated a morbid condition hitherto unrecognized in standard works. Post, of Boston, has described it in one case as a "fibrous ring" in the prostatic urethra. Neither name is founded upon post-mortem examination, and both may hereafter be shown to be inaccurate.

I have demonstrated this condition as the cause of obstinate cystitis in three subjects, each under thirty years of age; the last two were essentially identical with the first, which is here outlined: A boy of nineteen was referred to me, complaining that so long as he could remember he had suffered from frequent and painful urination; intervals of micturition less than an hour, day and night, except that occasionally they would lengthen for a day or two to three or four hours; pain was felt, during urination only, at bladder-neck and along the urethra; the urine was acid and contained considerable pus. Tuberculosis was suspected, but no abnormality of epididymis, prostate or seminal vesicle detected; urethral infection and injury were denied. A sound was arrested in the prostatic urethra by an obstacle that permitted only a fine bougie to pass; this condition remained during anæsthesia.

The finger introduced through a perineal incision found the distal

end of the prostatic urethra closed and resisting all the force that could be safely applied; by means of conical bougies and forceps the channel was gradually dilated until the finger passed the obstruction, which was found to be a band of firm tissue surrounding the outer third of the prostatic urethra. Nothing abnormal was detected in the bladder.

Drainage for a few days was followed by complete recovery of the normal vesical condition and disappearance of pus from the urine. Eight months later there was no return of the former symptoms.

While I have by digital contact proved this condition to exist in only three cases, there is reason to suspect that it is not rare; for stretching of the prostatic urethra from the meatus has in some additional instances relieved a mild cystitis for which no other cause was found.

PAPILLOMA OF THE PROSTATE.

This relatively rare tumor is for clinical purposes identical with the more frequent papilloma of the bladder, since it commonly arises from the vesical surface of the prostate (see Tumors of the Bladder). Small tumors of this variety have been discovered post mortem on the urethral surface of the prostate. Grünfeld recognized and removed such a growth through the endoscope. The writer excised one at the urethro-vesical orifice through a perineal urethrotomy.

CANCER OF THE PROSTATE.

Under this term are included two histological varieties of malignant growth—carcinoma and sarcoma. Clinical distinction between the two can rarely be made, unless particles of size sufficient for microscopical examination are found in the urine or removed in the eye of a catheter.

Cancer of the prostate arises (1) by extension from adjacent organs (rectum, bladder), (2) by infection (metastasis) from cancer of a distant organ, and (3) as a primary tumor. Only the last requires consideration here.

Primary cancer of the prostate occurs chiefly in patients under ten and over fifty years of age, though the intermediate periods of life furnish not infrequent instances. Jolly found, out of 35 cases, 7 in boys under ten and 21 in men over fifty. Engelbach found, out of 89 carefully observed cases, 9 in boys under ten (3 less than one year of age) and 49 in men over fifty. About seven eighths of the tumors are found to be carcinoma, the remainder sarcoma.

Morbid Anatomy.—When sufficiently developed to attract attention, the disease is usually found diffused through a large portion of the gland; in some cases a well-defined neoplasm is observed. For a time the disease remains limited by the capsule of the prostate, though sometimes distending this to the size of an orange; then it invades adjacent

lymph-glands and adjacent organs, often filling the entire true pelvis, compressing the rectum and raising the bladder; perhaps extending through the various pelvic outlets.

Destruction of the walls of the cavities adjoining the prostate—urethra, rectum, bladder, and seminal vesicles—follows, the escape of their contents into surrounding tissues inducing suppuration. Invasion of the vascular channels may occur, followed by metastasis of the growth in distant organs.

Symptoms.—Intermittent hæmaturia at intervals of weeks may be the first and for a time the only symptom. Some difficulty and pain in urination; pain in the perinæum, down the thighs, in the rectum or sacral region; cystitis, complete retention; profuse hæmorrhage with the urine, are often observed later. In other cases attention is directed chiefly to the rectum by pain and difficulty in defecation, tenesmus, and dysenteric discharges. Sometimes both bladder and rectum participate in the disturbance of function.

No one of these symptoms is invariably present.

Diagnosis.—Cancer of the prostate frequently fails of recognition, partly from neglect to make digital examination per rectum, partly because cancerous enlargement is not distinguished from the more frequent and familiar hypertrophy of the prostate. Three of the most important and constant diagnostic points are (1) progressive emaciation and pallor; (2) hard enlargement of lymph-glands in the groins, within the pelvis (detected by bimanual examination), and in Scarpa's triangle; (3) irregular, nodular enlargement of the prostate. The discovery of recognizable cancer tissue in the urine, or inspection of a malignant ulcer through the cystoscope, is conclusive evidence.

Differential diagnosis need take cognizance only of simple hypertrophy, from which cancer in the early stage may be difficult to distinguish; indeed, malignant growth may be grafted upon hypertrophy; its advent may be detected by the symptoms enumerated.

Failure to distinguish between simple and cancerous enlargement of the prostate led the older surgeons to the belief that prostatic cancer is very rare; more accurate observation in recent years reveals it relatively often.

Duration.—In children the fatal termination is reached in a short time, even three months to four weeks after the first pronounced symptoms. In elderly men the progress of the disease is less rapid—from one to three, four, even five years.

Treatment.—Palliation of distress should be attempted. Pain is mitigated by morphine; cystitis and urinary retention by the treatment outlined for prostatic hypertrophy; rectal disturbance by avoiding constipation and by hot-water injections. The iodine trichloride is especially

valuable for bladder irrigation because of its hæmostatic properties. The catheter must be used with extreme care, since the friable tissue of the prostatic tumor is easily wounded. Czerny even passed a catheter through a prostatic cancer into the rectum. When other measures fail to relieve the vesical disturbance, a permanent suprapubic exit for the urine should be made.

The tumor sometimes completely occludes the rectum, compelling the institution of an artificial anus in the groin or loin.

Extirpation of the cancerous prostate has been performed ten times; the patients who survived the operation have all died of recurrence within a few months. While improved diagnosis and consequent earlier operation may in the future furnish better results, the present record offers but little encouragement for the operation.

CYSTS OF THE PROSTATE.

These are of three kinds: 1. Hydatids, which must be rare, as only three authentic instances are furnished by post-mortem records. 2. Cystic dilatation of the prostatic utricle from occlusion of its orifice. English found five such cysts during the examination of the bodies of seventy newborn infants, and suggests that this retention may be the occasional cause of urinary retention in the newborn. 3. Cystic distention of occluded prostatic glands. These retention cysts, containing prostatic secretion, are not infrequently found post mortem, especially in elderly subjects. Clinical recognition of them is very rare. The writer reported a case to the American Medical Association in 1886. The patient, a man about thirty years old, had for months experienced extreme difficulty and pain in expelling the urine; examination showed no obstruction, a catheter entering the bladder readily. Upon perineal section, the finger detected a cyst suspended from the prostate above the vesical orifice, which it almost completely closed. Removal by the finger was followed by restoration of the normal vesical condition.

THE FUNCTIONAL DISORDERS OF MICTURITION.

By JOSEPH D. BRYANT, M. D.

URINATION, or the normal act of passing urine or an analogous fluid, is a function that characterizes the more important forms of animal life. However, in the accepted sense of the term, the act is especially identified with the higher orders of this form of life. In the human family the proper performance of the act appeals not only to the bodily comfort of the individual, but to the sense of propriety as well, in the vast majority of responsible beings. Therefore, the irresistible demands of urination not infrequently impose great physical and sentimental burdens, both in health and disease. The urgent and varied importance of this demand instantly justifies the attempt to treat of the disturbances of this function somewhat independently of the morbid states that cause them. In the adoption of this course, the established morbid modifications of urination are employed in an interrogative sense, with the view of eliciting the abnormal conditions that are peculiar to each of them.

Physiology of Urination.—In order to interpret properly the abnormalities of an act, the physiology of the act should be well understood in each of its recognized parts. The component parts that influence the act of urination may be classified practically as follows: 1, The canal for the escape of the fluid—the urethra; 2, the receptacle for the fluid—the bladder; 3, the fluid itself—the urine. The urethra and the bladder are of muscular structure, lined with sensitive mucous membrane, and vivified with nervous motor influence; and, too, each of these parts is animated and modified in its function by supplemental influences of voluntary and involuntary nature. The normal urine varies in amount, chemical constituency, and rapidity of production, and therefore often modifies the act of expulsion, within the limits of health. If, now, these three elements of the act of urination be normal, and their supplementary influences be rightly attuned, physiological urination ensues. If, on the other hand, discordant action, or disturbed sensibility of one or more of the controlling influences of the act happen, then disordered micturition is the result. Normal urination takes place about once in five hours during the twenty-four hours of a day. It is commonly passed on retiring at night and rising in the morning, the remaining acts being distributed

through the day. The amount voided daily varies from thirty to sixty ounces (about 900 to 1,775 cubic centimetres). The average quantity voided per hour is two and one tenth ounces (62 cubic centimetres). Physiological urination is induced by the presence in the bladder of a certain amount of urine, which causes the sensation that leads to its expulsion. The contraction of the muscular walls of the bladder, supplemented by the contraction of the diaphragm and abdominal muscles, cause the evacuation of its contents. The relaxation of the sphincter vesicæ and the actions of certain ones of the urethral muscles (accelerator urinæ and compressor urethræ) co-operate harmoniously in aiding and completing the execution of the act. At first the act of urination is voluntary, but when begun it is continued by the involuntary contraction of the bladder alone. Voluntary effort increases the flow at all times, and especially is this influence noticeable at the completion of the act; then the abdominal effort and the contraction of certain perineal muscles complete the expulsion of all the urine except the few drops that remain behind in the bladder. The flow of normal urination can be arrested by voluntary effort at any stage of the act, if the capacity of the bladder has not been taxed by the unwonted amount of urine it contained. The center of the reflex influence that incites the bladder is thought to be located in the lumbar region of the spinal cord, and its action is modified by the inhibiting influence of the sympathetic filaments which arise from a ganglion located near the same place. It is difficult, indeed, to determine definitely the frequency of normal urination, as it varies in different individuals, and is influenced by trivial causes. The amount of fluid taken, the action of the cutaneous surface, the chemical constituency of the urine, and the influences of mental emotions, exercise an action in modifying the frequency of urination within the limits of health. But, as already indicated in the preceding text, the normal act of urination commonly takes place once in five or six hours during the twenty-four, being less frequent at night. When, however, the healthy habit-limit of the individual is frequently or continuously encroached upon, either by the effect of avoidable or unavoidable causes, then abnormal urination ensues.

ABNORMAL URINATION.

Abnormal urination, or micturition, is modified as follows: 1, as to the length of time between the acts; 2, as to the length of time associated with the act; 3, as to the effort necessary to the performance of the act; 4, as to the unnatural sensations connected with the act; 5, as to the physical appearance of the stream.

- | | | |
|---|---|--|
| 1. The modification of the length of time between the acts gives rise to— | { | Increased frequency of micturition.
Diminished frequency of micturition.
Retention of urine.
Overflow of urine. |
|---|---|--|

Frequency.—The frequency of the act may be morbidly increased or diminished. The former state is dependent on any condition that incites the bladder to a more frequent expulsion of urine than normal, and it is commonly related to those influences that exaggerate the normal sensation which stimulates the organ to contraction. These influences may act directly or through reflex channels. Stone, gravel, foreign bodies, and morbid growths in the bladder, stimulate it to contraction directly, or by reason of the secondary inflammatory changes which their presence causes in the mucous and muscular structures of the organ. Inflammation of the lining membrane and muscular walls of the bladder, from whatever reason, also inflammation of the prostate, are common causes of this manifestation, and the more acute the cause the more urgent is the demand and the briefer the intervals between the acts. Irritability of the neck of the bladder following gonorrhœa, or dependent on the venous congestion of the neck and floor of the bladder in prostatic hypertrophy, or disease of the rectum, and vesical irritation from irreco gnizable causes, lead to increased frequency of micturition. The presence in the bladder of blood, pus, and other fluids foreign to it, alone or mixed with urine, excite abnormal frequency of its contraction. In fact, it can be safely asserted that “the bladder will retain unheeded a greater amount of normal urine than of any other fluid, both in health and disease” (Gouley). Incomplete emptying of the organ, caused by prostatic, urethral and other obstructions to the urinary flow, and by diminished power of the bladder walls, hastens the frequency of micturition by causing a rapid over-repletion of the viscus. Concentric hypertrophy of the bladder, with or without cystitis, sexual excesses, and neuralgia of the neck and body of the bladder, unduly hasten the frequency of micturition. Diseases of the spinal cord and tumors of the medulla cause frequent micturition by a modification of the reflex center of the former, and the center of urinary excretion of the latter structure. The expulsive sensation of the bladder is incited also by an increase in the amount of urine from any cause, by changes in its specific gravity and chemical constituency, and by the presence of foreign matters and decomposing changes in it. An increased amount attends hysteria and such emotional causes as fear, apprehension, etc.; saccharine and insipid diabetes; it follows the administration of diuretics, also chronic interstitial nephritis and amyloid degeneration of the kidneys. All varieties of cystitis and of marked prostatic enlargement stimulate a more rapid excretion of urine than normal, and therefore increase its amount, and thus add correspondingly to the amount of suffering attending its expulsion. Changes in the specific gravity and chemical constituency of the urine go practically hand in hand together. Acute general inflammatory diseases, dyspepsia, saccharine diabetes, lithæmia, oxaluria, and certain

medicines, as cantliarides, add elements to the urine in a greater amount, or of an unnatural character, which so modify its nature as to increase the frequency of micturition by the influence of augmented vesical stimulation. Suppurative, tuberculous, and malignant diseases of the kidney often add pus, blood, and other products to the urine, which, like decomposing urine, cause frequent micturition by direct action of the lining membrane of the bladder itself. Certain other disorders increase the frequency of micturition through the reflex influence they exercise on the bladder, as renal calculi in the kidney pelvis, and especially so during their passage through the ureters into the bladder; also, diseases of the rectum, anus, perinæum, and spinal cord, possess a potent influence in this respect.

Diminished Frequency of Micturition.—This disorder is of less frequent occurrence than the former one. Other things being equal, any influence that lessens or destroys the normal sensation that stimulates urination, or impairs or delays the motor influences that accomplish the act, decreases its frequency; as, the blunted sensation attending the stupor of various diseases, especially typhoid and typhus fevers, and cerebral diseases; also, following the use of narcotics, alcoholics, etc. Persons of indolent habits urinate less frequently than do those of an active life. The recumbent posture, in health and disease, lessens the frequency of micturition, not only by lessening the amount of urine produced, but also by delaying and diminishing its pressure influence upon the neck of the bladder. The entrance to the bladder of a small amount of urine is attended by diminished frequency of micturition, for, if other things be equal, the slow collection of fluid in the bladder delays the sensation that stimulates expulsion. Still, in this instance, if the specific gravity be greatly increased, or if the urine contain blood, pus, or other foreign matter of undue stimulating nature, then the acts of micturition are not diminished in frequency, and may be much increased in this regard. Diminished excretion of urine attends kidney inflammations, and suggests the danger of impending suppression. Free perspiration, the ingestion of a small amount of fluid, the administration of medicines that delay metabolism, and profound lesion of the spinal cord, diminish the production of urine, and may therefore lessen the frequency of micturition.

Retention of Urine.—This disorder is distinguished by the presence of a morbid accumulation of urine in the bladder, which should remain only for a time, but which continues there until removed by the aid of mechanical agents, or such therapeutical measures as heat, narcotics, and anæsthetics. This condition is divisible into two classes—viz., complete and incomplete retention. Retention is dependent either on obstruction of the urinary channel or diminished expulsive force, or on both combined. The obstructing causes are located at the urethro-vesical orifice

and in the urethra itself. The prostatic enlargements of old age, tuberculosis of the prostate, prostatic concretions, and tumors, are the common impediments at the urethro-vesical orifice. Acute congestion of a chronically enlarged prostate is a most fertile source of retention. Acute prostatitis of the parenchymatous or follicular forms, incited by gonorrhœa and other causes, together with abscess and cancer of the prostate, frequently close this opening. Pedunculated tumors of the bladder, stone, and foreign bodies in it; bony displacement from fracture and dislocation of the pubes; inflammation of the seminal vesicles; blood-clots, and the products of cystitis, not infrequently exercise a similar influence. Stricture is the most frequent form of urethral obstruction, and when acute congestion is added thereto, the canal is often promptly closed. Foreign bodies and polypi in the urethra may suddenly close the canal. Atresia, false passages, rupture, and other formed wounds of the urethra often effect its closure. Large and open valves within the canal are assigned as a cause of retention, especially if looking backward and modified by inflammatory changes. Diminished expulsive force is the result of lessened muscular and nervous action. Acute over-distention of the bladder so paralyzes its muscular coats that for some time thereafter retention ensues. Repeated over-distention, voluntary or otherwise, is frequently followed by atony of these coats; and, too, atony arises from unknown causes, and in both instances retention is common. Spasmodic contraction of the urethro-vesical orifice and of the deep perineal muscles not infrequently cause temporary retention of urine. Prostatic enlargements and prostatic tumors may so interfere with the action of the bladder walls as to cause incomplete retention. Paralysis of the body of the bladder alone so cripples the act of expulsion that the normal neck of the organ offers an obstacle to the escape of urine, and retention thus ensues.

Modified nervous action leading to retention follows inhibition of the lumbar center by a strong stimulus, caused by surgical operations on the urinary organs, rectum, and contiguous structures. Severe injuries here, and the pain attending micturition, cause retention for the same reason. Obviously it should be remembered that retention commonly follows operations for hæmorrhoids, prolapse of the rectum, fistula-in-ano, etc. Retention of the urine is frequently a complication of severe injuries and surgical operations on distant parts of the body, and of acute over-distention of the bladder due to exhaustion of the lumbar center. Hysteria, mental emotions, and some forms of syphilitic and inflammatory disease of the brain; diseases that blunt the sensibilities, as typhus and typhoid fevers, paresis, etc., are quite frequently, indeed, complicated with urinary retention dependent on general disordered nervous influence. In the preceding enumeration of the causes of retention no differential dis-

tion is made between those causing complete and incomplete retention.

Complete retention is rare indeed, for it is unusual to have an obstruction or loss of power so profound as not to permit the escape of a few drops of urine from time to time. Complete retention must be discriminated from rupture of the bladder and from suppression and extravasation of urine.

While neither time nor propriety will permit me to enter into the details of a differential diagnosis, still I can not forego the opportunity of strongly impressing one fact in this connection—viz., the great importance of a rectal digital examination as the first means of determining the presence of an over-distended bladder.

Incomplete or partial retention is often mistaken for involuntary and frequent micturition, as it is characterized by frequent urinary acts, feeble streams, and perhaps dribbling of urine. However, the presence of residual urine in the bladder, as demonstrated by the introduction of a catheter, establishes conclusively the presence of retention.

Overflow of Urine.—This expression contemplates very properly the pre-existence of retention. Overflow of urine results from its damming in the bladder, the same as the damming of water elsewhere than in the body causes overflow; for, when the receptacle is filled and the supply continues, overflow necessarily follows in all instances. It is now apparent that the causes of overflow are the same as those of retention, except perhaps in cases of complete retention, and even then the difference is one of degree rather than of variety. In overflow the discharge is commonly continuous and dribbling, hence it is often mistaken for true incontinence. Sometimes brief interruptions of the flow happen, due to temporary impediments at the urethro-vesical opening or within the urethra itself. While these cases are rare, yet they may be mistaken for increased frequency of micturition. However, a thoughtful examination of the case will lead to prompt recognition of the true state of affairs.

2. Modification of the length of time associated with the act gives rise to—
- | | |
|---|-------------------------------------|
| { | Irrepressible micturition (Gouley). |
| { | Urgent micturition. |
| { | Retarded micturition. |
| { | Interrupted micturition. |

The time required for the act of physiological urination is brief and usually uneventful, being modified only by the amount of urine passed, and the length of time given to the purpose. Abnormally, the length of time between the demand for and the execution of the act may be so brief as to admit of no delay, the urine being voided in defiance of the will. This is known as—

Irrepressible Micturition.—Chiefly the bladder and its nervous supply, and incidentally the urine, are concerned in the causation of this

form of morbid micturition. In this disorder the normal urination sensation is so exalted as to cause the motor impulses of the act to be irrepressible. While cystitis itself is the chief cause referable to the bladder, still, the exciting causes of the cystitis frequently add the direct and baneful influences peculiar to their nature to the former infliction. Stone, prostatic enlargement, and morbid growths are striking and common examples of the exciting causes. Acute cystitis, with or without polyuria, often causes this disorder. Catheterism of an acutely inflamed bladder produces irrepressible micturition, and therefore should be avoided when possible. Over-distention, due to improvidence or bad judgment on the part of the patient, or to carelessness of the physician, may provoke its occurrence.

The nervous element of this disorder is frequently illustrated by the catheterism of neurotic patients; also by the so-called incontinence of children. In the latter it is thought to depend on inordinate and uncontrollable contraction of the bladder, hence denominated chorea of the bladder by some authors.

Urgent Micturition.—In urgent micturition there exists a strong yet controllable desire to urinate. The term is a relative one, and represents a lesser degree of disorder than the irrepressible variety, as well as an exaggeration of the normal desire to urinate. It is a much more frequent manifestation in morbid conditions of the bladder and nervous system than is imperative micturition. It happens, too, from causes that are foreign to any established disease whatever, but are incident to mental emotions, preoccupation, suggestive sounds, ideas, etc. Inasmuch as urgent micturition is akin to the irrepressible form, it is not likely to be due to dissimilar causes, but rather to similar ones acting in a less emphatic manner. It is characteristic, therefore, of all forms of cystitis, prostatic enlargement, and inflammation, especially with instrumental interference. Inflammation and irritability of the urethra and hyperaesthesia of the external genitals cause it. In a word, the step from increased frequency of micturition to urgency of the act is often a brief one, for the causes of the former are provocative of the latter, especially when the sensation exciting the latter is exaggerated by a greater diseased action, or by inattention, heedlessness, or inability to meet the requirement of increased frequency on the part of the patient. Urgent micturition is common in many cases in which disease of the bladder and urethra and their appendages acts no special part, as in polyuria, irritating urine, moderate over-distention of the bladder, due to neglect and preoccupation; mental suggestions, as the sound of falling water; mental emotions, as apprehension, fright, etc. It is proper to say, however, that the diuretic effects of mental emotions add much, indeed, to the urgency of the act. Urgent calls to micturate occur frequently in rupture of the bladder.

Retarded Micturition.—This signifies an abnormal increase in the length of time essential to the performance of the act of micturition. The retardation may depend (1) on delay in “starting the stream”; (2) on slowness of emptying the bladder; (3) on a combination of these influences. This variety of micturition does not contemplate the presence of a degree of interference of sufficient moment to call for a distinctly marked voluntary effort to overcome the obstruction influence, as a decided effort is a part of difficult and obstructed micturition rather than of the retarded variety. The approach of the retarded form of micturition is so stealthy, especially when it is dependent on a chronic cause, as to escape for a time the notice of the patient himself. Actually its presence may be first appreciated only when the time permitted for a special performance of the act fails to completely accomplish the purpose. Not infrequently a patient is reminded of the previous existence of retarded or delayed micturition in his own case when he is brought suddenly face to face with severe obstruction to the act, caused by the influence of some indiscretion he has recently committed. It follows, therefore, that many of the causes of retarded micturition will, in becoming more pronounced, or when supplemented by other agencies, lead more or less promptly to difficult and obstructed micturition. Retardation from delay in “starting the stream” arises from slight obstruction in the urinary canal, and also from diminution or delay in the action of the expulsion-forces of the bladder. Enlargements, tumors, concretions, and abscess of the prostate cause this disorder in a more or less appreciable degree during the course of their development. Urethral stenosis from stricture, and from the external pressure of periurethral abscess and tumors, exhibit it; also, obstructions from foreign bodies, concretions, and blood-clots in the urethra and urethro-vesical orifice, exercise a similar influence. The presence in the bladder of a small stone often retards the escape of urine at the outset; usually, however, its influence is noticed more frequently near the termination of the act, as then the stone is pressed more directly against the urethro-vesical orifice. Delay in “starting the stream” and emptying the bladder are jointly associated with atony of the bladder, after over-distention from voluntary and involuntary causes. It happens with diminished vesical power arising from special nerve-lesions, independent of genito-urinary disease; with mental emotions, as shame, etc., seen during the efforts of micturition before a class of students; with blunted sensibilities from the effects of shock, narcotics, and asthenic diseases. The congestive swelling at the urethro-vesical orifice which is incident to the hours of sleep and the horizontal posture, causes retarded micturition on arising in the morning. However, while retardation disappears during the day, still it may be repeated again from time to time on arising. This form of retardation is not dependent on established stricture.

ural changes of the bladder, prostate, or urethra. Retardation of the emptying of the bladder, due alone to diminished capacity in the urethral canal, follows urethral stenosis from all causes, also urethritis and urethral inelasticity caused by gonorrhœa, and neuralgia, and congestive swelling of the urethro-vesical opening.

Interrupted Micturition.—The stream of normal micturition is a free and continuous one until near the completion of the act; then the spasmodic efforts attending its conclusion cause the urine to be discharged in jets, either with or without a complete interruption of the flow. The interruption of the stream in this disorder is usually transitory, yet, it may soon become permanent, and quickly lead to retention of urine. The causes of interrupted micturition relate to the bladder and the urethra. The mechanism of these causes, in a large majority of instances, is like that of a valve which, when thrown by the force of a stream into or against a canal or opening, causes its complete closure, until a change in its position, or a modification of the forces directed against it, removes the obstruction for the time being, and thus permits the resumption of the flow. Stone, blood-clots, pus, stringy mucus, pedunculated growths, foreign bodies, etc., act in this manner when forced against the urethro-vesical orifice. Over-distention of the bladder may be attended with interrupted micturition, which in this instance is probably due to the improvement of the bladder tone, which results from the interruption of the efforts to expel its contents. A movable growth at the neck of the prostate, and the presence of obstructing valves in the urethra, cause this modification of urination. Superadded congestions at the seat of disease, especially of inflamed prostate, and urethral stenosis, cause matutinal interference with the stream, in the following manner, it is thought: In the morning, when the bladder is over-repleted, the patient strains with beginning micturition, and thus engorges the vessels still further, which engorgement is often sufficient to close the already narrowed canal, and the stream is arrested. A few minutes after this, however, if the patient makes a further attempt, a small amount of urine is passed. Perhaps this is repeated several times, until finally the bladder is emptied by installments. This cause of interrupted micturition often leads promptly to difficult micturition.

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| 3. Modification of the effort necessary for the performance of the act leads to— | { | Difficult micturition.
Obstructed micturition.
Incontinence of urine.
False incontinence.
Involuntary micturition.
Unconscious micturition. |
|--|---|--|

Normally, no effort is necessary for the performance of urination, except the physiological effort attending the completion of the act, which has been described already.

Difficult Micturition.—This form is commonly associated with the retarded variety of micturition, and often, though less frequently, with the painful form. In brief, anything that weakens the forces causing evacuation of the bladder, and anything that obstructs the flow of urine, is apt to cause difficult micturition. When the difficulty is constant at the beginning of the act, it is an indication of urethro-vesical contraction and of prostatic obstruction. When it occurs constantly at the close of the act, it is, in a general way, indicative of stone in the bladder, and also of the stone's close proximity to the urethral orifice. Difficult micturition may be defined, therefore, as a form of micturition that calls for greater efforts of expulsion than does the retarded variety, or the act is made difficult by the pain and apprehension associated with it. Prostatic enlargements and prostatic tumors, urethral obstruction of all kinds—stone, blood-clots, and foreign bodies in the bladder—are established causes of difficult micturition. Atony and paralysis of the bladder from special nervous lesions and general neurosis are causal connections of this variety of micturition. Acute inflammation of the urethra and of the prepuce, when complicated with phimosis; chaneroid of the glans or foreskin with a contracted preputial orifice, cause marked retardation, and frequently difficult micturition. Since the nature of the causes of retarded and difficult micturition are substantially similar, the more infrequent causes of the latter will not be repeated here, as they are placed already under the former title.

Obstructed Micturition.—In this variety of micturition the greater effort necessary to expel the urine depends on the presence of obstacles in the urethral canal and at the urethral orifice. These obstacles are similar in nature and situation to those that cause retarded and difficult micturition, and therefore the reader is referred to those titles for further information in this regard. As heretofore stated, the degree of hindrance is greater in the obstructed than in the retarded form of micturition. It is not practical, however, to make a distinction, as to degree of obstruction between the difficult and obstructed varieties of micturition, and therefore these terms are often used interchangeably in connection with impedimentary interference with urinary discharge. After this, these expressions diverge somewhat in their application, for, while obstructed micturition signifies always a greater or less difficulty in emptying the bladder on account of obstruction to the flow, yet difficult micturition happens without the presence of any such appreciable lesion. As an apt illustration of the latter assertion, the difficulty of voiding urine in the presence of real or prospective pain, caused by the act, is cited.

Incontinence of Urine.—This expression signifies the inability of the bladder to restrain the escape of its normal contents. As commonly understood in this disorder, the urine escapes as soon as it reaches the

bladder, and the small quantity that may be retained in the bladder by the force of gravity, or by the opposition offered to its outflow by the curves of the urethra, does not conflict with the above definition.

Incontinence is commonly though unwisely divided into two varieties, viz., true and false incontinence. The condition of true incontinence is accepted as similar to that of incontinence, and is therefore properly defined above under the title of the latter expression. False incontinence as employed indicates the same modifications of urination as those happening in involuntary and unconscious micturition and overflow, with which expressions it is often interchangeably employed. The term "false incontinence" is objectionable, not only on account of its nosological inaccuracy, but also by reason of the confusion it causes in many minds as to its exact application. If incontinence be present at all in a case, then, indeed, the conditions causing it must conform to the definition applied to that term, otherwise incontinence can not exist. Moreover, the conditions assigned as causes of false incontinence and the phenomenon attending this act are such as permit of their proper and ready classification under other common and simple titles. While the term false incontinence will not be excluded from consideration, still, the inconsistent and unnecessary use of the term will appear as the assigned causes and the manifestations of this disorder are placed before the reader. Incontinence depends on any modification of the urinary bladder which permits the early, continuous, and uninterrupted flow of urine from it, irrespective of the patient's will. In fact, the urinary bladder becomes a passive part of the urinary canal, owing to the loss of power to retain its contents, which, when favored by gravity, escape as fast as received within the organ. This variety of incontinence is caused by unsymmetrical development or hypertrophy of the prostate, which prevents closure of the sphincter vesicæ, and permits the urine to dribble away at once on entering the bladder. A degree of concentric hypertrophy of the bladder that will not permit its distention, and for this reason all the urine above a few drachms must flow away at once, is incorrectly regarded by some as incontinence. And, too, this illustration seems similar to frequent and involuntary micturition, but there is this difference between them: in concentric hypertrophy of the bladder, the patient not only urinates without willing it (involuntary micturition), but he must urinate in spite of the volition not to do so (irrepressible micturition); therefore, this is not a proper example of incontinence. Paralysis of the sphincter vesicæ and the sphincter muscles of the urethra, with or without loss of power of the detrusor urinæ muscle, dependent on a lesion in the course of the nerves themselves, or of the nervous center, malformation of the bladder, exstrophy, etc., and of the urethra, as the opening of the ureters into the urethral canal, especially near the external meatus, will cause incontinence.

The last abnormality excludes the bladder from the urinary tract, and, although the symptoms are typical of incontinence, still the conditions do not conform to the definition given of incontinence. Fistulous communications between the bladder and rectum; relaxation of the sphincter vesicæ in hysteria, and perhaps in grave disease, as typhus and typhoid fevers, cause incontinence. It is well to be reminded of the fact at this time that paralysis of the body of the bladder alone causes retention of urine; and that paralysis of the neck of the organ only causes incontinence and not retention.

So-called False Incontinence.—In this form of disorder the contents of the bladder are wholly or partially discharged, owing to the loss of control of the expulsion forces, during a conscious (*involuntary micturition*—overflow) or unconscious state (*unconscious micturition*).

Nocturnal incontinence of children is a good illustration of *unconscious micturition*, and the causes provoking it may be of either a direct or reflex nature, such as: fissure of the neck of the bladder and vesical calculus; increased irritability of the bladder from unknown causes; increased quantity of urine, as in diabetes, nephritis, and with increased ingestion of water; irritant nature of the urine, from undue acidity, hyperalkalinity, and medical agents; anal irritation, due to pin-worms, fissure, eczema, etc.; hyperæsthetic state of the external genitals dependent on stricture, phimosis, balanitis, etc.; and the psychical influence of dream impression—e.g., a child dreams he has found a suitable place in which to urinate.

General debility, spinal disease, injuries and diseases of the spinal cord, diseases of the vesical nervous supply, and acute febrile diseases are also among the many common atonic causes of this variety of unconscious micturition.

Involuntary micturition in children, distinctive of chorea of the bladder, is a source of great annoyance, not only by reason of the uninviting catastrophe it inflicts, but also on account of the uncertainty as to the time of infliction. In these cases, though the urine is properly retained for a while, still, with scant warning often, it may be expelled at any moment with a gush. Various theories are advanced to account for this phenomenon in children, among which may be mentioned that of Oberländer, who believes it is only due to reflex irritation in the urethral and anal openings. Fauboren says the cause is insufficiency of the sphincter vesicæ, which permits a little urine to enter the upper portion of the urethra, and its presence there causes a further performance of the act by the excitation of reflex contraction. Enuresis in these cases is attributed by some to a lack of power of retention and enfeeblement of the voluntary power of the sphincters at the neck of the bladder and commencement of the urethra. In addition to this particular variety of involuntary micturition, many of those conditions recognized as potent

in the production of unconscious micturition are not infrequently associated with the involuntary act in a causative sense.

Involuntary Micturition.—In adults this arises from both hyperæsthesia and anæsthesia of the mucous membrane of the bladder and urethra. The former condition occurs not infrequently in those who suffer great hardships and deprivation, as noted during the French campaign of Moscow. The presence of an irritable bladder, due to the common causes of this condition already mentioned, gives rise to involuntary micturition also. It is not difficult to understand the influence of a hyperæsthetic state of the bladder mucous membrane on the act of urination, since the irritability incident to the hyperæsthesia excites expulsive efforts that overcome that sphincteric control, and involuntary or irrepressible micturition ensues. Skene, in speaking of micturition of the anæsthetic state, explains it thus: "The stimulation is sufficient to excite contraction, but the sensation is not acute enough to weaken it." The involuntary micturition of those afflicted with typhus and typhoid fevers, and of other grave asthenic states, properly exemplify this phase of the disorder.

Over-distention of the bladder is a most fertile cause of so-called false incontinence (overflow), especially in old men who are affected with prostatic obstruction; and it may follow over-distention from any cause, irrespective of the age of the patient. It is instructive to note the fact at this time that overflow and so-called false incontinence can be employed synonymously with perfect propriety in connection with over-distention of the bladder from obstructive causes. To avoid repetition it may be stated that the causes of unconscious or involuntary micturition in children act as causative agents of these disorders in adults as well. However, acute febrile diseases, general debility, fright, vesical calculus, cystitis, and the effects of spinal traumatism, are more pronounced causes in this regard in adults than in children. Senility often leads to incontinence, regardless of the prostatic obstruction so frequently connected with it at this period of life.

Retention is classified also under this division of the general arrangement, for the obvious reason that the majority of its associated disorders here are of such a nature as to suggest at once the probability of the occurrence of retention, when the causes of the associated disorders are more fully advanced in an unhindered course.

4. The unusual sensations attending the act (painful micturition).	{	Time of sensation, as,	{	Before micturition.
			{	During micturition.
				After micturition.
	{	Seat of sensation (direct and reflex), as,	{	Hypogastrium.
				Bladder.
				Perinæum.
				Rectum.
				Glans penis.
				Elsewhere.

Painful Micturition.—In normal urination no annoying sensations are in any way connected with the act. In fact, a pleasurable feeling only attends the evacuation of the bladder and the flow of urine through the urethra. However, in disease of the bladder, urethra, and of their appendages, and also attending abnormalities of urinary composition, painful sensations, varying in nature, degree, situation, and relationship with the act, often take place. As to its nature, the sensation may be a cutting, burning, or itching one, etc., as characterized by the appreciation of the patient, and depending on the variety, situation, and acuteness of the disease. In degree it varies from that of an annoying sensation only to one of pain and intense suffering even, being controlled in this respect largely by the acuteness of the diseased process; for, as a rule, the acuter the process, the severer is the pain arising from it. The situations of these abnormal sensations are commonly located at the seat of the disease, but this fact must be accepted in a general sense only, as reflex sensations frequently happen at a considerable distance from the lesion that causes them, and where no other evidence of disease exists. The relationship of abnormal sensations to the acts of micturition should be carefully noted, since the occurrence before, during, or following the act is very important for the establishment of a correct diagnosis.

Discomfort and pain of the urinary tract *before micturition* frequently arise from the local action of ultra-irritating urine; from increased sensibility of the prostate and mucous membrane of the bladder from various causes, *plus* the direct pain, peculiar to the cause itself. The mechanism of the production of painful micturition is a simple one, being due to the contact of slowly accumulating fluid with the abnormally sensitive structure within the bladder, and to the contact of irritating agents with these structures when normal. The urine is made irritating by those diseases and conditions which destroy the proper equilibrium between its fluid and solid constituents. An abnormal increase in the solids or diminution of the fluids leads to similar results in this respect. Acute inflammatory diseases; profuse perspiration; small ingestion of fluid; frequent copious liquid alvine discharges, oxaluria, pyuria, lithuria, aleoholies, certain medicines, as cantharides and turpentine; vesicles of kidney hydatids, and inordinate alkalinity and acidity, cause irritating urine. Both acute and chronic cystitis and prostatitis; prostatic hypertrophy and prostatic tumors, cancer, etc.; symptomatic prostate; inflammation of the seminal vesicles; gravel; circumscribed and general vesical irritation; over-distention; contraction with hypertrophy and ulceration of the bladder walls, etc., cause more or less pain and discomfort before micturition. Pyonephrosis, calculous, and tuberculous kidney are sometimes indicated in their earlier stages by pain before and during micturition. The acute diseased processes of the bladder, prostate, and urethra

especially, add their own peculiar pain to that caused by the contact of urine with their diseased surfaces during the act of micturition.

Pain during micturition depends on diseased action within the bladder and within the urinary canal. Those diseased conditions of the bladder just enumerated as causing pain before the act frequently cause more or less pain and discomfort during the expulsion of the fluid, and the acute varieties of these diseases are more pronounced in this respect than are the chronic. The contraction of the bladder in the presence of acute inflammation of its lining membrane and of the prostate causes pain of the bladder, due to the contraction itself, and of the prostate from the increased pressure attending the contraction. The pain caused by these acute conditions, by the presence of stone and foreign bodies in the bladder, and of ulcer and fissure of the neck of the bladder, are increased during the completion of the act, as at this time they are brought more closely within the grasp of the bladder, and are therefore subjected to a more direct pressure than when urine intervenes between them and the bladder wall. Neuralgia of the neck of the bladder is of fickle presence and severity, and while it may happen at any stage of the act, yet it most frequently attends that of expulsion. Pain in the urinary canal during the discharge of urine attends all varieties of urethritis, circumscribed and general; also urethral chancre and chaneroid and simple ulceration, stricture of the urethra, balanitis, and occasionally phimosis cause it. Changes in the chemical constituency of the urine, and the presence of irritating substances in it, as already enumerated, frequently cause more or less pain during the act, and may be followed by pain and disagreeable sensations after its completion. This is especially true in the presence of increased sensibility and inflammatory and ulcerative processes of the canal.

Pain diminished after micturition indicates that contact of urine with the bladder and urethra, or distention of the bladder, was the probable cause of the pain. Pain at the time of micturition may be at the seat of the disease causing it, or be referred to a distant part—e. g., pain at the end of the penis may be referred there from the neck of the bladder; pains radiating down the thigh or occurring in the testicles or groin are often referred from the pelvis of the kidney or the ureter. Pains in the sole of the foot, calf of the leg, and the thigh are a part of the history of urethral stricture. Usually prostatic pains are felt in the perinæum and lower portion of the rectum; bladder pains over the pubis; kidney pains in the loins, etc. While some of the illustrations here given are not exactly in line with the subject under consideration, still their mention now will serve to emphasize the importance of those manifestations in the actual as well as in a differential diagnostic sense. Many of the examples just cited are common ones, and there-

fore serve the more emphatically to impress the diagnostic importance of a detailed consideration of both the local and reflected pains of disordered micturition in connection with the diseases themselves. The diagnostic significance of painful micturition in various abnormal conditions can be best considered for practical purposes in the following manner :

(1) The disease causing it; (2) the seat and kind of pain commonly produced by the disease; (3) the relation of the pain to the act of micturition.

Acute Cystitis.—In this disease pain is located most frequently in the bladder itself, being often more severe at the neck than elsewhere. The severity of the pain is in direct proportion to the process that causes it, being much more pronounced in acute than chronic diseases of the membrane. Abnormally irritating urine, from chemical decomposition and other causes, adds to the intensity of the suffering in all phases of the disease. The relationship of the occurrence of pain with the entrance of urine to the bladder is governed by the situation of the disease and the site of greatest sensibility, as modified by the position of the patient, and the degree of distention of the organ. If the inflammation be limited to the neck and base of the bladder and the patient be erect, pain follows quickly the entrance of urine to the organ, since it is then brought in contact at once with a diseased surface. However, if the position of the patient be so changed as to delay or limit the degree of urinary contact with the diseased surfaces, then pain is lessened, or it disappears until sufficient accumulation ensues to encroach on the seat of disease, and then the pain returns or increases, and is relieved only by prompt micturition. Distention of the bladder increases the pain if the disease be general, and produces it when sufficient urine collects to cause impingement on circumscribed disease of the membrane. If the inflammation be general and of equal degree and uncomplicated, pain comes promptly, increases with uniform intensity, and, although augmented during micturition, is relieved or greatly lessened by the act. Also in this disease pains are often felt, conjointly or separately, along the urethra, in the perinæum and rectum, above the pubis, at the end of the penis, and radiating down the thigh, and, as a rule, the acuter the diseased process and the severer the bladder pain, the more constant and pronounced are these reflex sensations. As to the kind of pain, it is variously characterized in this disease, and is apparently modified in this respect by its situation. The local pain in the bladder is sharp, pricking, smarting, and burning in character, and it is entirely relieved or greatly lessened by the emptying of the organ. Not infrequently a straining pain (tenesmus) follows micturition, especially if the neck of the bladder be much involved by disease. The referred pains in the perinæum, above the pubis, in the

rectum, at the end of the penis, and radiating down the thigh, are classed as heavy burning pains. As may be readily inferred, the painful manifestations of chronic cystitis are less vigorous—the pain being aching and dull in character—and they do not lead so soon to uncontrollable results. Still, a general dependent connection of the phenomenon of painful micturition in acute cystitis can be easily distinguished in the chronic form.

Neuralgia of the Neck of the Bladder.—In this disease, while the pain is always located at the neck of the organ, still, it not infrequently shoots from there into the urethra, rectum, and perinæum. It exhibits the same uncertainty, as to the time of occurrence, that distinguishes similar pains elsewhere in the body. It is sharp and darting in character, and although it happens during the intervals of micturition, still it presents itself most frequently during the act.

Fissure and Ulcer of the Neck of the Bladder.—These conditions, especially the former, are more frequently present than they are commonly considered to be. The fissure not infrequently extends into the upper end of the urethra. The pain attending them is located at the neck of the bladder, is of a burning character, more or less continual, and attended by the feeling of an unvaried desire to micturate. Much straining or tenesmus is present, and after micturition the pain and burning are most intense.

Stone and Gravel in the Bladder.—Each of these agents causes painful micturition by contact with the bladder wall; the former, as a rule, causing the greater disturbance.

In stone the pain is dull and commonly located in the bladder during the intervals of micturition, if it be present at all. However, even then dull reflex pains may be present along the urethra and behind the glans, or may radiate to the hips and thighs, the perinæum, rectum, sacrum, and above the pubes. Still, these painful manifestations during this time are modified by the position and activity of the patient. If pain be caused while standing, the horizontal posture often lessens or relieves it. If the patient be quiet, no pain may be present, irrespective of his position; but on walking, running, or riding, pain quickly occurs, and the intensity is proportioned directly to the degree of jarring and jolting he experiences. The pain with stone is caused not only by the presence of the stone itself, but likewise, and in great part often, by the cystitis which its presence excites. Pain with stone is usually present before, during, and after micturition, and especially are these facts true if cystitis have ensued. While in rare cases of stone no pain at all is present, yet practically it varies in degree from that of an exaggerated urinary sense to one of agonizing intensity. The dull pain before micturition is due to the contact of the accumulating urine with the inflamed surfaces

caused by the stone, and also in a degree to the presence of the stone itself. The pain during the act is the severest of all, especially at its termination, for then the stone is spasmodically grasped by the sensitive bladder walls. During this time sharp and severe reflex pains invade the urethra and glans, and violent tenesmus often ensues, together with dull, severe, deep-seated pubic and perineal and rectal pains. If any be present, the pain following the act is the least of all, and is largely the result of the physical violence inflicted on the neck and walls of the bladder by the stone itself during the act of micturition.

Gravel in the bladder causes no distinctive pain in that organ before micturition, and is usually washed out by the escaping urine during the act. Therefore, the smarting, burning pain suggestive of the presence of gravel in the urine takes place in the urethra during the emptying of the bladder, and rarely remains but a short time thereafter.

Hydatid Cysts of the Kidney.—In this instance the pain and disturbance of micturition depend on the presence in the urine then in the bladder of the vesicles and fragments that have passed down from the growth above. The discharge of these agents does not take place rapidly in the majority of instances, therefore periodical attacks ensue at intervals of days and even of months. Their presence in the urine may cause retention with the dull and bursting pain of this disorder, followed by severe strangury with radiating burning pains of the urethra and glans penis. Evacuation of the bladder is followed by instant relief.

Acute Prostatitis.—The pains experienced in this disease differ somewhat according to its variety, and the differences are more a matter of degree than otherwise, their comparative relationship to the act of micturition being still quite pronounced. In the parenchymatous form the suffering arises from the disease itself, from the irritating effects of the urine on the diseased organ, and from the act of micturition. Heat and throbbing pain are present in the prostate, attended with dragging pain in the scrotum, and an aching sense of fullness in the perinæum and rectum. These pains are present at all times during the acute stage of the disease, and are increased often by the irritating effects of accumulated urine, and are always exaggerated by the act of urinary expulsion. Pains independent of these precede, attend, and follow the act of micturition. The burning, smarting pains before the act are due to urinary contact, and are located at the neck of the bladder and upper extremity of the urethra. As the urine increases in amount, the consequent pressure from it increases their severity, and often gives rise to similar shooting pains in the urethra, the glans, the perinæum, and scrotum. During micturition these painful expressions are increased in severity, and at its finish often become excruciating, being attended with violent tenesmus, severe reflex pains in the glans, and deep-seated subpubic pains, caused by the vigorous

contraction of the bladder on the inflamed prostate itself. The phenomena of acute prostatitis and of stone in the bladder are similar during micturition, especially if cystitis be present with the latter. Following the act the pains incident to it quickly subside, leaving the patient to suffer only from those sensations peculiar to the disease alone, and with apprehension born of the memory of the past and sustained by the fear of prospective suffering. In other varieties of prostatitis the painful phenomena of micturition bear a similar relationship to the act as in the acute form, but are less severe in character and often incomplete in sequence.

Acute Inflammation of the Seminal Vesicles.—Burning pain and discomfort in this disease are present at the base of the bladder, and may be referred to the spermatic cord, glans penis, perinæum, and rectum. The accumulation of urine in the bladder increases the vigor of these sensations, and the act of its expulsion adds greatly to the suffering, being often attended by severe vesical and rectal tenesmus. However, marked relief follows at once the evacuation of the bladder.

Prostatic Hypertrophy of Old Age.—The degree of painful suffering in this disease depends on whether or not cystitis or other complications have taken place. If uncomplicated, then a dull pain or a sense of weight and fullness is present in the hypogastrium, rectum, and perinæum, and perhaps in the bladder as well. These sensations are constant exhibitions, and, as a rule, are not modified in any essential particular by the act of micturition. However, in some cases, as urine collects in the bladder, the sense of weight and pain increases, and the desire to micturate is soon incited, and during the performance of the act a burning pain occurs at the neck of the bladder and in the course of the urethra, followed by a dull pain behind the pubes, in the perinæum and rectum, and perhaps the glans itself, near the completion of the act. These disappear promptly after the cessation of vesical contraction and the emptying of the urethra. If the urine have undergone decomposition changes, then these latter exhibitions are more often present and better pronounced. If *cystitis* or *stone* be present with prostatic hypertrophy, then pain attends the accumulation of urine, and it is increased in proportion to the amount contained in the bladder, the grade of cystitis, and the size and roughness of the stone. The discharge of urine under these circumstances causes increased pain, referable to the neck of the bladder, urethra, and perhaps more distant parts, and, at the completion of the act, severe subpubic, perineal, urethral pains, and pain at the glans penis take place, attended not infrequently by tenesmus of greater or less degree. After micturition, in this as in preceding instances of prostatic involvement, the more distressing symptoms rapidly subside, leaving behind only such as belong to the diseased bladder and prostate during the intervals of micturition.

Prostatic Cancer and Tumors of the Prostate and Bladder.—In prostatic cancer pain depends primarily on the cancer itself, and secondarily on obstruction to the flow of urine and the consequent cystitis induced by the presence of the cancer. The same may be said of other tumors of the prostate, and bladder tumors as well. But, inasmuch as these growths differ in no important particular from other forms of prostatic disease and cystitis, as regards the pain with the act of micturition, it seems useless to give to them a more detailed consideration in this connection.

Retention and Contracted Bladder.—In either of these conditions the pain is described as a splitting one, and it is referred properly to the bladder alone. The mechanism of its causation is similar in both instances, being dependent on painful distention of the bladder from over-repletion by urine. The painful micturition incident to a contracted bladder happens more frequently than that due to retention, for the obvious reason that, when a diminished capacity receives a normal supply, over-distention occurs much more quickly than when the capacity and supply are proportionate to each other. The pain in both of these conditions precedes micturition and is promptly relieved by it.

Urethral, Inflammatory, and Structural Changes.—In all varieties of urethral inflammations, whether general or circumscribed, painful micturition ensues. Urethral ulcerations cause a similar exhibition, irrespective of their nature, extent, and location. Urethral strictures, likewise, often cause painful micturition. The degree of pain experienced during micturition in all varieties of urethral disease is proportionate, of course, to the sensibility of the diseased surfaces, and also, in a measure, to the amount of urethral distention attending the act. These pains are of a smarting, burning, or cutting nature in the great majority of instances. They are located in the urethra, and correspond to the extent and situation of the diseased surface of that canal. These pains are direct and are caused by the contact of the passing urine as it escapes from the bladder. The pain is manifest, therefore, during the act of micturition, and may be present for a short time thereafter. Balanitis, posthitis, and ulcerative changes within the foreskin cause pain during micturition, and this pain is increased in severity if these diseases be complicated by phimosis.

Irritating urine, dependent on decomposition, hyperalkalinity, and hyperacidity, and other chemical changes of it, causes painful micturition. The presence in the urine of pus, cancerous and hydatid products, and the effect on it of cantharides, turpentine, cubebs, etc., often produce a like result. The presence in the bladder of irritating urine begets discomfort and painful sensations there before micturition, and similar exhibitions often attend at the neck of the organ and in the urethra during its discharge, but thereafter they quickly subside. Tenesmus may attend and

follow the act of micturition in many instances, especially after the use of the remedial agents just mentioned.

5. The character of the stream may be modified as to its—	Force.	Increased force.	{ Feeble stream. Perpendicular stream. Dribbling stream. Slobbering stream.
		Diminished force.	
	Size.	{ Increased size of stream. Diminished size of stream.	
	Form.	{ Oval stream. Flat stream. Spiral stream. Bifurcated stream.	
	Direction.	{ Radiating stream. Deflected stream.	

The characteristics of the normal stream during urination are not easily to be described. The periodical appearance of the stream forms such a very important though unappreciated part of one's every-day existence, that its normal aspects are recalled only when something unusual happens to it. It belongs really to the order of natural, every-day objects which, though noticed by us, their presence makes no distinct impression on the perceptive sense except something quite unusual attends them.

Force.—This element of urination depends, on the one hand, on the degree of energy exercised by the bladder and the abdominal muscles; and, on the other, it is controlled by the restraining conditions obtaining in the urethra. The degree of force is estimated by the distance to which the stream can be propelled.

The force is much increased by the powerful and uncontrollable contractions of the bladder in those conditions recognized as causing irrepressible micturition. The causes of urgent micturition and not infrequently those of the involuntary act increase the force of the stream, especially when no obstruction to the escape of urine obtains.

Diminished force is the result of indolent or weakened vesical contraction, and also of the presence of obstructing influences in the urinary canal. Diseases of the spinal cord, brain, and of the nerves supplying the bladder directly; also such asthenic diseases as typhus and typhoid fevers, and atonic states for other reasons, are suitable illustrations of the conditions producing diminished force of the urinary flow due to an enfeeblement of the propelling power. The obstructive influences of the flow that serve to weaken the force of the stream are present at the neck of the bladder in the urinary canal, and are often connected with the prepuce alone, especially in children. Stone in the bladder, hypertrophy, tumors, and enlargement of the prostate from all causes; narrowing of the urethra from constrictions, growths, and obstructions, and phimosis, congenital and acquired, weaken the urinary flow. In a few

words, the diseases that give rise to overflow and retention of urine, to retarded, difficult, interrupted, and obstructed micturition, are causative as well as of diminished force of the urinary discharge.

Size, Form, and Direction.—These characters of the stream can be advantageously considered together. If the conditions in the urethra be such that during micturition the meatus is fully distended by the stream, then to the distended meatus the stream will owe both its size and shape (oval). Urethral stenosis, urethral narrowing from any cause and at any point, will surely modify all these qualities, causing the stream to be flat, small, or twisted (spiral); if near the external meatus, curved (deflected) or divided into two streams (bifurcated), each propelled in different directions; or one driven forward and the other tumbling perpendicularly down (perpendicular); or into several streams, each with a different direction (radiating).

Continuity of the stream is an important quality for consideration. Normally the stream is full, oval, and vigorous, the size being increased when additional expulsive efforts are made. Toward the completion of the normal act the stream becomes flattened, owing to diminished force, and, too, it is flattened during disordered micturition, if diminished force be a characteristic feature of the disorder. With obstructive disease of the prostate the stream may be spasmodic, or the fluid be passed in a feeble, perpendicular, dribbling, slobbering manner. The abnormal conditions of certain portions of the urinary tract and their modifications of the stream are submitted to the attention of the reader as illustration of the mechanism of stream variation in connection with obstruction and parietic changes associated with urinary flow.

Prepuce.—In phimosis, if the preputial opening be smaller than the meatus, the stream is modified in size, shape, and sometimes in direction. The reasons for these changes are too obvious to require any further mention.

Meatus Externus.—Such changes here as epispadias, hypospadias, multiple urethral openings, or a contracted or deflected single opening, will exercise an evident influence on the size, shape, and direction of the stream.

Urethral Inflammation causes congestion and swelling of the mucous membrane of the urethra, and therefore occasions a change in the size of the stream, it being smaller; in the shape, it being flat, forked, or twisted, etc.; and often in direction and continuity being devious and attended by some dribbling at the end of the act.

Organic Stricture.—This formation influences the size of the stream, and for this reason the force, form, and direction of it also. If the diminution in size have been coming on gradually, the presence of increasing stricture is quite surely demonstrated. An inordinately small stream in a

case usually points to one of three conditions, viz., contraction at the urethro-vesical orifice, urethral stenosis, or impaction of calculous matter in the urethra. In stricture the form of the stream may be twisted, forked, or radiating, as when divided into several streams. The direction of the stream may be upward, downward, etc., or two streams may be exhibited, one perpendicular, the other propelled. Impairment of the force of the stream happens, too, and this effects its continuity, causing the last few drops to dribble away, because the expulsion-wave does not pass the stricture.

Prostate.—Hypertrophy modifies the force of the stream, causing it to be weak and slow. The lessened force diminishes the size of the stream, which, failing to distend the meatus, prevents the proper form at once. A bifurcated stream is not infrequently present in this connection. In hypertrophy the continuity of the stream is often changed, due at first to delay from congestive swelling, but later it may be interrupted or entirely stopped by the valve-like action or increased growth of the hypertrophied organ. This valve-like action may affect both the size and form of the stream, especially with straining, causing dribbling and slobbering of urine. In parenchymatous prostatitis and in prostatic and periprostatic abscess and prostatic cancer the stream becomes gradually small and forceless; if combined with vesical irritability, the continuity of the stream is modified by sudden and premature vesical contraction.

Neuralgia of the Vesical Neck.—If the bladder act without power, the force and size of the stream are diminished; but if it act spasmodically, with power, then these peculiarities are increased.

Spasmodic stricture of the urethra interrupts the continuity of the stream, it being normal between the spasms.

Incontinence, from whatever cause, modifies the continuity of the stream, and dribbling of urine ensues; but in the great majority of cases dribbling indicates overflow.

Bladder.—In concentric hypertrophy impeded bladder contractions diminish the force of the stream, causing it to be feeble and slow.

Atonic Conditions.—In these conditions the force of the stream is lessened, and if they be complicated by causal obstruction, then the stream is weak and dribbling.

General Neuroses.—If these exist alone, then the stream is feeble and slow.

Vesical Paralysis.—When vesical paralysis is complete and limited to the body alone, dribbling of urine ensues as the result of retention with overflow. If incomplete, then the stream is feeble and slow and followed by dribbling. Limited retention may be present in these cases and cause increased frequency of micturition. If only the neck of the organ be paralyzed, then uninterrupted incontinence ensues.

Cystitis and Trachelo-cystitis.—In these diseases the accompanying spasmodic and vigorous contractions of the bladder increase the force and size of the stream, change its form and direction, and may also affect its continuity.

Stone in the Bladder.—If the urethra be normal and the stone movable, the continuity of the stream is interrupted or enfeebled, but a change in the patient's position may restore the stream to its normal characteristics, if complications be not present. Foreign bodies in the bladder cause similar phenomenon as stone, when movable.

DISORDERS OF MICTURITION TABULATED.

URINATION.	Normal urination.			
		(1) The length of time between the acts, and gives rise to—	{	Increased frequency of micturition. Diminished frequency of micturition. Retention of urine. Overflow of urine.
		(2) The length of time associated with the act, and gives rise to—		Irrepressible micturition. Urgent micturition. Retarded micturition. Interrupted micturition.
		(3) The effort necessary for the performance of the act, and gives rise to—		Difficult micturition. Obstructed micturition. Incontinence of urine. False incontinence. Involuntary micturition. Unconscious micturition.
		(4) The sensations attending the act, and gives rise to pain as follows (painful micturition):		Time of sensation. { Before micturition. During micturition. After micturition. Seat of sensation (direct and reflex). { Hypogastrium. Bladder. Perinæum. Rectum. Glans penis. Elsewhere.
	Abnormal urination, or micturition, is modified according to—			
		(5) Characteristics of the stream modified as to its—	{	Force. { Increased force. Diminished force. { Feeble stream. Perpendicular stream. Dribbling stream. Slobbering stream.
				Size. { Increased size of stream. Diminished size of stream.
				Form. { Oval stream. Flat stream. Spiral stream. Bifurcated stream.
				Direction. { Radiating stream. Deflected stream.

DIAGNOSTIC SIGNIFICANCE OF PATHOLOGICAL MODIFICATIONS IN THE URINE.

(INCLUDING THE MOST PRACTICAL METHODS OF URINE ANALYSIS.)

By EUGENE FULLER, M. D.

THE above-entitled article, owing to the space allotted, can not be exhaustive in character ; consequently, the attempt will be made to bring out as clearly as possible only the points which are apt to confront the busy practitioner, and the methods by which he can deal with them. It has seemed well to classify the subject as follows :

1. General characteristics of the urine.
2. Chemical constituents of the urine, subdivided as follows :
 - a. The normal chemical constituents.
 - b. Those that are normal only when present in very small amounts, abnormal when abundant.
 - c. The abnormal chemical constituents.
3. Organized sediments.
4. Miscellany.

1. GENERAL CHARACTERISTICS.

These include color, odor, transparency, chemical reaction, volume, and specific gravity.

Color.—It is customary to classify urine with reference to color as pale (i. e., colorless to straw color), normal (i. e., amber yellow), or high color (i. e., reddish yellow to mahogany). Other colors are abnormal. The coloring matter of the urine and bile taken together are supposed to represent approximately the amount of decomposition of the red blood-corpuscles. Just what the coloring matters are is still a subject of some discussion among chemists. An occasional specimen of pale urine in a given case is of no moment. The continuous voiding of such, however, would lead one to suspect either one of the conditions where a great volume of urine is habitually secreted, thus reducing the normal amount of color by dilution, as in diabetes mellitus or insipidus, contracted kidney, etc., or some condition of anæmia where there are few red blood-corpuscles to undergo the change.

High-colored urine is, *vice versa*, indicative of concentration. Such a condition, which is of moment only when continuous, exists with individuals who drink little, and in cases where the secretion of the kidney is interfered with, as in fever, parenchymatous nephritis, surgical suppression, and in some neuroses.

Dark-colored urines generally indicate some abnormal pigment, such as blood or bile; more rarely the action of some drug, usually carbolic acid or one of its derivatives; sometimes rhubarb or senna. Blood in urine soon loses its red color and becomes dark. These dark shades vary all the way from a smoky tinge, where there is little present, to an inky black, where there is much.

In the great majority of instances where the urine is so colored, the red blood-corpuscles are present and contain all the pigment. There is, however, a rare condition described as hæmoglobinuria, where the urine is discolored by the blood-pigment only, there being present no corpuscles. Such a condition sometimes exists in diseases where there is a great dissolution of the red corpuscles, as in scurvy, typhus, and malignant malarial fevers, and after the inhalation of arseniureted hydrogen gas. The microscope confirms the diagnosis only in the first class of cases. In the cases where the pigment exists without the corpuscles, on adding a very little acetic acid and boiling, a brownish coagulum forms. The spectroscopic test is, however, for such conditions more exact. Bile in the urine gives a dark-yellow or brownish color, usually with a greenish tinge. It is always found where there is jaundice, and occasionally in cases of phosphorus-poisoning. A rough and valuable test to prove the presence of bile is to shake a specimen of the urine in a partially filled bottle, the greenish tinge to the bubbles being very characteristic. Another good demonstration is to spread out a drop of the suspected urine on a white porcelain surface, and into the middle of this, by means of a glass rod, to place a little concentrated nitric acid. There will be promptly, in case bile is present, a play of colors, the yellow changing first to green, then to blue, violet, ruby red, and back to yellow again.

Some observers have called attention to the fact that in cases of melanotic cancer, frequently the urine on standing will turn rapidly brown, or even black (Neubauer and Vogel, *Analysis of the Urine*, translated by Cutler, page 368).

Odor.—Little information is to be gained from the odor of freshly secreted urine aside from suspecting or detecting fermentative changes. Many drugs, such as sandal-wood, asparagus, turpentine, etc., lend their characteristic odors to the urine.

Transparency.—Urine, when voided, is normally transparent, with, on standing a few minutes, a little cloud of mucus near the middle of the vessel. If the urine freshly passed is turbid and cloudy to any marked

degree, then we commonly suspect one of two causes, either a deposit of earthy phosphates due to an alkaline condition of the urine, or free pus. (Chiluria, a rare condition, will be considered later under another heading.) A few drops of acetic acid will dissolve the phosphates and render the urine clear in the first instance, thus deciding the question. If, however, the urine has had a chance to cool slightly after being passed, amorphous urates may be thrown down, causing at times great opacity. If this urine is now heated again in a water-bath, it speedily becomes clear, such not being the case in the other two conditions. A water-bath is recommended rather than the flame, for by heating with a flame albumen, if present, may be thrown down, and thus obscure the test. There is another cause for turbidity in freshly voided urine which occasionally exists largely by itself, but which is usually associated with pus, namely, bacteria. Here the turbidity is apt to be rather slight. There is no sparkle to the urine, but a slightly ground-glass appearance, and on standing there is no tendency for the opacity to settle, leaving a transparent zone near the top. The microscope demonstrates this condition. It is seen in cases where bacteria have been introduced through instrumentation. Some urines on voiding show a great general turbidity due to pus. It will be found after they have remained standing a few hours in a glass that all the pus has settled at the bottom in a sharply defined, not adhesive, solid mass, leaving the supernatant fluid perfectly clear. This condition is, in a general way, indicative of pus coming from the kidney region.

Chemical Reaction.—Normal urine is moderately acid. A urine may be temporarily neutral or even slightly alkaline, and not be pathological. Just what causes the acid reaction of normal urine is still rather a mooted question among chemists. It is probably only due in small measure to the presence of free acids, but chiefly to the acid salts. To test the acid reaction of urine a piece of blue litmus-paper is dipped partially in, the part immersed rapidly turning red in case the fluid is acid. If it is alkaline or neutral, there is no change. Red litmus-paper to test the question between a neutral and an alkaline reaction is rarely necessary, for one can readily detect alkalinity from decomposition by the odor, and normal alkalinity is sufficiently demonstrated for practical purposes by the failure of the fluid to change the color of the blue paper. One of the functions of the kidneys is to separate the chemically acid salts which occur in the urine from the alkaline blood. When, however, the blood is rendered excessively alkaline by medicines or herbivorous diet, enough alkaline material passes through the kidneys to neutralize or more than neutralize the natural acidity of the urine. This explains how it is possible for a normal urine to be alkaline.

Any concentrated urine is likely to be very acid, and, conversely, any

diluted urine is apt to be neutral, simply from the abundance or absence of the solid elements which go to make up the reaction.

Decomposed urine is alkaline. Certain fermentation germs acting on urea cause its decomposition into carbonate of ammonium. When this decomposition takes place within the body, the urine becomes putrid and alkaline before being voided. In such an instance the germs of fermentation have been introduced mechanically from without.

All urines for examination should be voided in clear vessels. If a number of such urines are watched and examined from time to time, it will be found that alkaline decomposition occurs much earlier in some than in others. As a rule, the urine of females decomposes earlier than that of males, probably due to the admixture of vaginal material. One class of urine, it is often found, will keep for many days, frequently for a week, and still remain strongly acid. Such a condition of affairs, there being pus present, is a diagnostic point in favor of disease of the pelvis of the kidney.

Volume.—The quantity of urine secreted in a given space of time, usually twenty-four hours, is a matter of importance in many conditions. Care must be taken in making measurements that there be no loss at stool. In a rough way the amount secreted in twenty-four hours in health varies between forty and fifty ounces. Large individuals secrete more than small ones, those who drink freely more than those who do not. As a general rule, it may be said that the quantity of urine secreted depends largely on the watery condition of the blood, and the activity of the renal secreting epithelia. It has been calculated that ordinarily about one half the fluid drunk passes out of the system through the kidneys, the other half being eliminated by the skin, lungs, and bowels. During active exercise, hot weather, or in case of diarrhœa, very little of the fluid drunk may be eliminated by the kidneys. More urine is secreted during mental and bodily activity than during sleep, due in the former case to the activity of the renal cells. Many spring-waters, teas, drugs, etc., by increasing the renal activity, act as diuretics. To test the efficacy of these, comparative measurements before and while taking are most important.

The volume of urine is decreased in the early stages of acute febrile affections. Then later, as the fever subsides, it is apt to be increased beyond the normal. In most diseases, as death draws near, the quantity of urine is much diminished. This is often an important point. In the active stages of acute nephritis little urine is passed. This is also the case in all kidney affections accompanied with dropsy, while the dropsy is on the increase, the opposite condition existing while the dropsy is on the decrease.

After surgical operations on the urinary tract, it is most important to

watch carefully the amount secreted. Complete surgical suppression at times ensues, and not a drop of urine is secreted for a considerable period. These cases are usually fatal. After these operations, if the volume of urine is good, the greatest danger is averted. It is very important to measure carefully the amount of urine passed in these cases, and, in fact, in all cases, in a measured glass graduate, and not depend in the least on the testimony of the patient or attendants; for frequently, in the cases where the amount passed is very small, the desire to urinate is most frequent, and consequently the common impression is that the quantity secreted is great. In some forms of kidney disease where there is no dropsy the volume of urine passed is apt to be very great, as in the case of interstitially contracted kidneys. In diabetes mellitus the volume is generally much increased—so much so that often one's attention is directed to the disease by the amount of urine passed. Many text-books would lead the student to believe that a considerable increase in the volume of urine was one of the cardinal accompaniments in this disease. This, however, is not so. There may exist in this condition even a diminution in the volume. I have had under observation for several years a case of this trouble in an elderly lady, where the amount of urine passed in twenty-four hours is invariably in the neighborhood of thirty-two ounces. In diabetes insipidus the amount of urine is increased, generally much so, together with the amount of solid ingredients which the urine contains. Such a condition of affairs is almost always associated with some form of nervous debility. The nervous system plays a great part in regulating the quantity secreted, and if an obscure case arises in practice bearing on this point it is always well to examine carefully the nervous system. Hysterical individuals at times pass a great abundance of urine.

Specific Gravity.—The specific gravity of the urine which is so easily read off from the urinometer is closely associated in clinical investigations with the volume. It is so much easier, however, to find the specific gravity than the volume, that it is very much more commonly employed in diagnosis. From the specific gravity can be inferred the amount of solid material in the urine. In a general way urea represents half the solid constituents. Normal specific gravity varies from 1,015 to 1,025 or thereabout. Any one can bring the specific gravity of his urine temporarily down to the neighborhood of 1,005 by imbibing freely, especially of diuretic fluids. So a temporary increase of volume and decrease of specific gravity suggest nothing pathological. A permanent condition of this sort, however, points strongly to an interstitially contracted kidney or to a decrease of a dropsical condition, and sometimes to anæmia. The opposite state of affairs is found in both diabetes mellitus and insipidus. In these cases the specific gravity is liable to be quite high, often considerably over 1,040. In office practice where the volume is not known

a high specific gravity together with a high color (no other evidence of anything wrong being found) suggests a small volume and general concentration.

2. CHEMICAL CONSTITUENTS OF THE URINE.

Under this heading only the substances will be considered which with our present knowledge by reason of their variations or presence are of diagnostic value to the practitioner. For a thorough treatise which would be of special interest only to the physiologist or chemist, reference is made to Nenbauer and Vogel's *Analysis of the Urine*, or a similar work.

a. Normal Chemical Constituents (Urea).—This is the most important as well as the chief organic constituent of normal urine. It represents the final product obtainable by oxidization of a nitrogenous substance in an alkaline fluid similar to the blood. It thus represents the amount of bodily waste or combustion; much in the same way as ashes represent the amount of fuel consumed. The more work done, the more food digested, the more combustion; hence the more urea. This combustion in the body, owing to adverse conditions, is not always complete, and, as a result, substances representing incomplete combustion or oxidization are found in more or less amounts in the urine. Chief among these are kreatinine, kreatine, xanthine, uric acid, oxaluric acid, etc. Many of these are rare and hard to demonstrate, and of no practical importance. Uric acid and calcic oxalate are of importance, however, and will be mentioned further on. Urea itself is very soluble, and therefore one never sees its crystals among the urinary sediments. It is a white crystalline substance tasting much like saltpeter, neutral in reaction. On heating these crystals further combustion takes place, and finally nothing but carbon remains.

A healthy man on a mixed diet taking a fair amount of exercise ought to secrete from twenty-five to forty grammes of urea in the twenty-four hours. There is, however, considerable variation to this. Individuals on animal diet, for instance, secrete much more urea than those on vegetable. In any condition where there is great bodily wear, as after violent exercise, or during an acute febrile disease, the urea is increased. In making an examination into the quantity of urea only a mixed specimen of urine passed during the twenty-four hours should be taken, as the amount of urea varies greatly at different times, from being abundant after eating and exercise to being scanty after rest and sleep. Urea when not eliminated from the body, as in diseased conditions of the kidneys, acts as a poison, and sets up one of the many toxic trains of symptoms classed under the rather general heading of uræmia. It is with reference to uræmia almost wholly that the question of the quantity of

urea secreted becomes of importance to the general practitioner. By quantitative tests from time to time in these conditions the working power of the kidneys can be carefully noted, and thus the relative values of different eliminative drugs can be accurately judged, and the course of the disease often prognosticated. There are several methods of estimating the quantity of urea. Most of them are inaccurate or so difficult outside of a well-equipped laboratory as not to be practical. Dr. Charles Doremus, of this city, has rendered quite practical the bromine method by means of his ureometer, which is manufactured, together with directions for use, by Eimer and Amend. By carefully following these directions (which have been embodied here with a few alterations and explanatory clauses), fairly accurate results can be obtained.

Reagents necessary.—The sodium hydrate solution (100 grammes to 250 cubic centimetres of water, or six ounces to one pint of water) will keep indefinitely when tightly stoppered. Bromine, twenty-five cubic centimetres added to the above amount of sodium hydrate solution, will make the concentrated hypobromite of sodium solution. This solution does not keep very well; so, if but few tests are to be made, it is not well to make up but a small amount, observing these proportions. The bromine may be removed from the bottle in which it is kept by means of the nipple pipette. One cubic centimetre of bromine suffices for a test. More can be removed if a quantity of hypobromite is to be made up. Some care must be exercised in handling the bromine, since it gives off irritating fumes; but by the above method of procedure no inconvenience ought to be experienced.

This concentrated hypobromite must be diluted with its own volume of water. This can be done approximately.

The long arm and the bend of the ureometer must be filled with the hypobromite.

Having washed the pipette, draw up exactly one cubic centimetre of urine, pass the pipette through the bulb of the ureometer as far as it will go in the bend; compress the nipple *gently* and *steadily*. The urine will rise through the hypobromite, and the urea will instantly decompose giving out nitrogen gas.

Withdraw the pipette after the urine has been expelled, taking care not to press the nipple hard enough to drive the air out after the urine, and read the volume of gas after allowing the froth to subside. The ureometer indicates according to its graduation either in milligrammes of urea in one cubic centimetre of urine or grains of urea per fluidounce of urine.

It also indicates, by the signs + and — on either side of the central division, whether the urea is present in a normal quantity or is increased or diminished.

When the total quantity voided in twenty-four hours is known, the calculation of the amount of urea is very simple. Multiply the result found in milligrammes by the number of cubic centimetres voided, or the grains per fluidounce by the number of ounces voided.

The percentage by volume, or the milligrammes of urea per one hundred cubic centimetres of urine, is ascertained by multiplying the milligrammes of urea found by the test by one hundred.

Lowering the ureometer in a vessel of water until the water and hypobromite inside and out of the graduated limb are on a level, will give a more correct reading. The ureometer is graduated for 65° Fahr., and upon an experimental basis.

It is well to impress the fact that only urines which have not undergone decomposition are available for accurate estimations of the quantity of urea, for, as has been previously noted in such conditions, urea is rapidly converted into carbonate of ammonium.

Chloride of sodium is quite abundant in the urine. Its presence can be demonstrated by dropping into the urine a solution of nitrate of silver, a thick cloud of chloride of silver being precipitated. It diminishes much in quantity in some acute diseases, especially, it is stated, in pneumonia. It is not, however, of much diagnostic importance.

Phosphates of calcium and magnesium, otherwise called earthy or amorphous phosphates, are abundant and of some importance. These are the salts which render undecomposed alkaline or neutral urines turbid. Urines which when passed usually or frequently contain these salts in a state of precipitation suggest in the individual concerned some neurotic disturbance or the ingestion of much alkaline material. A few drops of acetic acid added to the urine will quickly clarify it with a slight effervescence. Under the microscope this precipitate appears as an amorphous sediment.

b. Uric Acid.—Uric acid, as has been stated, represents one of the products of imperfect combustion of nitrogenous substances, urea representing perfect combustion. It is pathological and of considerable diagnostic importance when it is abundant. At such times it can generally be easily seen by the naked eye, as the ordinary so-called brick-dust deposit at the bottom of the vessel in which the urine has stood for some little time. Uric-acid crystals, as found in urinary sediments and seen by the microscope, are always colored, the color varying from very light yellow to deep yellow, orange red, or dark red. The color is very diagnostic. The shape and size of the crystals vary greatly. They usually occur in pointed oval, lozenge, barrel, or dumb-bell shapes. They also have a tendency to agglutination at all angles, forming grotesque masses. They are very brittle, and when large are often fractured between the microscopic slides. The chemical test for uric acid is important. It is

frequently of use in analyzing urinary calculi, which contain uric acid or urates. It is well known as the murexid test. Evaporate the urinous residue containing the suspected uric acid in a white porcelain or glass dish placed in a water-bath. Then add a few drops of a fairly concentrated nitric-acid solution, and evaporate this residue as before. Then moisten the last residue with an ammonia solution, and the purple-red murexid appears. If now a drop of potassic hydrate is added, the color changes to a purple blue. Uric-acid crystals, owing to their strong tendency to conglomeration, often form calculi. These crystals may occur in abundance at the onset of a sharp cold, also in acute febrile conditions, in gouty and rheumatic subjects, in subjects devoted to high living, especially where little exercise is taken, in dyspeptics, in many neurotic individuals where a debilitated condition of the nervous system has been brought about as the result of overwork, worry, some acute disease, anæmia, etc. In many of these neurotic individuals the urine is subject to change suddenly from concentration with high color and uric acid to dilution with pale color and an abundant precipitate of earthy phosphates. To remedy these conditions one of the numerous causes must be sought out and corrected.

The Urates of Potassium, Sodium and Ammonium.—These exist in abundance under much the same conditions as uric acid. They are rather easily disintegrated, setting free uric acid. Urines which contain an abundance of urates rapidly become turbid on cooling, the urates becoming insoluble in the cold fluid. The color of the precipitate is frequently light, but sometimes quite reddish. Most of these urates under the microscope are amorphous in character but sometimes crystalline, which condition is seen in the clumps of spicules which form the so-called hedgehog crystals of urate of ammonium. For the diagnostic significance of the urates the remarks on uric acid apply. They at times help to make calculi.

Calcic Oxalate.—A small amount of this substance exists in normal urines in solution, the acid phosphates of sodium and a few other substances which are present in small amounts holding it in solution. Calcic oxalate, however, is of interest to the practitioner only when it exists in abundance, in which case it does not remain in solution, but appears in the urinary sediment as white, transparent, sharply defined crystals. These crystals are usually in the form of an envelope and their shape is very characteristic. No chemical test is needed to confirm the diagnosis as revealed by the microscope. Rarely a few appear rounded like blood-disks. Calcic oxalate forms calculi at times, though not nearly so often as does uric acid. Such calculi are commonly extremely hard—not very large but very rough, hence often called “mulberry calculi.” Only in the case of calculi is the chemical test for this substance necessary. This test is to

fuse some of it, quicklime being left as the residue if the heat is powerful. Red litmus-paper being moistened and applied will, such being the case, turn very blue. No individual can be in a good state of health in whose urine there exists more than a stray calcic-oxalate crystal. The existence of these crystals is very demonstrative of an unlied condition of the nervous system; and then again their presence in the urinary channels, by reason of their sharp cutting edges, sets up local symptoms due to direct irritation. They are rather frequently found associated with uric acid in neurotic individuals. Sometimes one of these sets of crystals will disappear for a time, the other variety taking the field. One very frequently finds these crystals in cases of spermatorrhœa—so frequently, in fact, that in those cases where the nervous symptoms associated with spermatorrhœa exist, calcic-oxalate crystals being present, the finding of free spermatozoa would seem to follow almost as a sequence.

In these calcic-oxalate cases there is often found an early history of mental worry or strain, youthful excesses or some debilitating disease where proper attention was not paid to convalescence. Then, again, this tendency is sometimes transmitted by inheritance, an instance being recalled where it has appeared in a marked degree through three generations. The local symptoms set up by the presence of the crystals in the urinary tract are usually in the form of paroxysmal attacks of sharp pain across the lumbar regions, often radiating down the thighs or toward the testicles or end of the penis. At such times frequent urination is of common occurrence. A stray blood-corpuscle and a considerable increase in the cloud of mucus are generally associated in the urinary sediment.

Cystine.—This substance exists in small quantities in most urines in solution. When it is in larger quantity than usual, it is precipitated in the form of whitish or light yellow, transparent, six-sided plates. These crystals can be confounded with nothing unless it be a rare form of uric-acid crystal. If there is any doubt, the murexid reaction can be tried to determine the question. Cystine, like uric acid, is one of the intermediate products in the combustion of nitrogenous substances. It differs from uric acid chiefly in the fact that it contains sulphur. Sulphur goes to make up about a fourth of its composition. Under just what pathological conditions cystine occurs in quantity is not known. It is very rare. The author during the last year has had occasion to observe one case. Here the cystine crystals existed in connection with uric acid. The patient when first seen was in a miserably weak, nervous condition, having been so since an attack of scarlet fever some few months previously. Under tonic treatment and rest he soon recovered. The chief interest that the practitioner has in cystine is in the fact that it forms,

though rarely, a calculus. Such a calculus is yellowish in color, rather soft, and usually small. The test for this substance is to dissolve some of it in potassic hydrate, then add a solution of acetate of lead, and boil; a black precipitate of sulphate of lead being quickly formed.

Indican, which seems to be a chemical combination of a saccharine substance with indigo, is normally present in small quantities. Its demonstration by setting free the indigo is as follows: Into a wine-glass pour half an ounce of concentrated sulphuric acid; to this add three drops of concentrated nitric acid; then from a dropper add thirty drops of the urine, and stir with a glass rod till everything is well mixed; then set on a shelf, with a piece of white paper for a background. In about fifteen minutes the solution, if the normal amount of indican is present, shows an amethyst color. When there is an increase in the indican, the color is more blue. Sometimes where the increase is great the shade of blue is very strong. Rarely indigo red takes the place of indigo blue. The blue (or red) tint gradually fades in the course of some minutes, leaving the solution about the same color as when it was first mixed. Jaffé (Pflüger's Archiv, vol. iii, page 448) has found that any causes which interfere with the action of the small intestine occasion an increase in the amount of indican. Mention is made of cholera, peritonitis, strangulated and incarcerated bowel, etc. Some diagnosticians, especially the French, lay considerable stress on an increase in indican, considering that, other causes for its increase being absent, some internal cancer or growth, especially of the brain, should be suspected. I have in mind the case of a gentleman who had consulted several leading men in this country for some indefinite nervous symptoms, without any positive diagnosis being made. He went to France, and a large amount of indican being found, a diagnosis, chiefly from this point, of tumor of the brain was made. This diagnosis was later sustained by the symptoms which developed, and was demonstrated as correct by autopsy. One should, however, be very careful in drawing any such radical conclusions as the preceding, since I have found a large amount of indican repeatedly in simply highly nervous and hysterical individuals.

c. Products of Chemical Decomposition of Normal Ingredients.—*Triple phosphates*, otherwise called *ammonio-magnesian phosphates*, are the chief products of decomposition, and appear as crystals in the form of rhombic prisms when alkaline fermentation sets in. When this process takes place in the bladder these crystals are deposited in great abundance, and if careful washing and disinfecting are not resorted to, phosphatic calculi quickly form. This state of affairs is very frequent in connection with catheter life where rules of cleanliness are not rigidly adhered to. This substance forms the outer coatings of many calculi. Such calculi are apt to be soft and mushy, and therefore after

the operation of litholopaxy it is difficult to be positive that all the fragments have been washed out. Carbonate of ammonium and other products of decomposition are secondary in amount and importance to triple phosphates, and have no individual importance in diagnosis. The chemical test for these phosphatic deposits is the addition of an acid, the precipitate being quickly redissolved.

Albumin.—The presence of any appreciable amount of this substance in the urine is pathological. One of the chief functions of the kidneys in their action as filters is to prevent the passage of albumin through them into the urine. Albumin in the urine does not necessarily indicate that it got there by reason of defective kidney secretion. It may have been introduced by reason of an injury to the mucous membrane in some portion of the urinary tract, with which condition blood or pus is usually associated. In small quantities also it may be present in cases where the urine contains considerable prostatic or seminal fluid.

The detection of albumin in the urine is, as a rule, a simple matter. The test with concentrated pure nitric acid is the standard one. Two to three drachms of the urine are poured into a sherry-glass. Then the glass being tipped, the nitric acid to the extent of half a drachm to a drachm is allowed to trickle slowly down the tipped side of the glass to the bottom, its specific gravity being much greater than that of urine. The line of division between the two fluids is sharply defined. If albumin is present, a distinct white layer will appear at this line of division. The more the albumin the greater is the density and thickness of this layer. This test is important, for by it not only is the presence of albumin detected, but the practiced eye can, by observing the layer quite accurately and at a glance, reckon the percentage by weight of albumin in the specimen. There are a few conditions which interfere with or obscure this test. In urines rich in uric acid or urates a zone of opacity is formed, consisting of nitrate of urea, which can easily be confounded with the albumin zone. This zone of nitrate of urea rarely forms immediately except when the specimen tested is quite cold. If this layer of nitrate of urea is carefully examined, it will be found that it is not at the line of division between the nitric acid and the urine where the albumin is always situated, but that it is above in the urine, and that a little clear area of urine is present between the bottom of this nitrate of urea deposit and the line of division between the two fluids. Sometimes both albumin and nitrate of urea exist together, causing some confusion. In such a case it is well to try one of the confirmatory tests. Once in a while some other substance which chemists have not at present determined, but which is thought to be myoein or mucin, is deposited by the nitric-acid test much as albumin, except that in these rare instances the upper layer of this pseudo-deposit is not at all defined in the way

albumin ought to be when the test is carefully and properly made, and generally the turbidity of the false deposit quickly extends, involving the whole specimen of urine. If the urine is decomposed the nitric-acid test is much interfered with, owing to the turbidity of such urines and also to the effervescence caused by adding the acid to the alkaline fluid. Then, again, pus or blood interferes. In the case of pus it is well to filter and then test. Where, however, there is enough blood present to interfere with the test, it is of no value to make any test for albumin, for the self-evident fact that if red blood-corpuscles can get into the urine, necessarily albumin can and must. If urine is turbid, owing to earthy phosphates, clarify it with a drop of acetic acid before testing. If turbid, owing to urates, heat the specimen in a water-bath till it is clear and then test. Owing to these few conditions which interfere with the nitric-acid test, the careful observer always has resource to another test for the sake of verification.

The heat-test is valuable and is somewhat more delicate than the nitric acid. Fill a test-tube about half full of urine (previously filtered only in case pus is present). To this urine add a drop of acetic acid to make sure of the presence of a little free acid. Then expose the upper area of the urine to a Bunsen or alcohol flame and let it come to a boil, turning the tube from time to time so that it will not crack. If the urine was turbid at the start the acetic acid will clear up phosphates and the heat urates, these last disappearing long before the boiling-point is reached. When the boiling-point is reached, albumin, if present, shows itself as a white turbidity. In some cases where the amount of albumin present is very small, the tube has to be held up against a dark object, as the coat-sleeve, to detect its presence, the difference then between the natural cool fluid in the bottom part of the tube and the slight turbidity of the boiled portion being better determined. This slight whitish turbidity in cases where the amount of albumin is very small increases to a condition where the boiled fluid resembles buttermilk, or even sometimes to a white, curdy mass which will not pour out of the tube. In such conditions the amount of albumin present is very great.

Millard's test is highly recommended for its delicacy in detecting and clearly demonstrating albumin when it exists in small amounts. Nothing under one twelfth per cent by weight of albumin can be seen by the nitric-acid test, while with the Millard test amounts very much smaller can be plainly detected. The following are the reagents used :

Acid. carbol. concent.	20 c. c.
Acid. acetic glacial	70 c. c.
Liq. potass.	220 c. c.

Here a drachm of the test reaction fluid is poured into a sherry-glass. About a drachm of the urine to be tested is sucked into a pipette. Then,

the finger being placed quickly over the end of the pipette as soon as suction is suspended, the urine is allowed to flow slowly down the inclined edge of the glass on to the fluid in the bottom. If any albumin is present, a very fine distinct white layer is deposited just at the line of division of the fluids.

Quantitative Estimation of Albumin.—The old-fashioned and rather common method of estimating albumin by employing the heat-test, and then, after the precipitate has settled, calculating the amount of albumin by the relation which the volume of the fluid containing the deposit bears to the whole volume, is very inexact and unsatisfactory. Esbach's method, by means of a test solution of picric acid, is well spoken of. I have never thoroughly investigated its accuracy. The method used by the writer is that taught by Prof. Wood, of the Harvard Medical School. Here the percentage of albumin by weight in a specimen is calculated by the appearance of the zone in the nitric-acid test. In applying this method it is necessary to add the nitric acid with as little agitation as possible, and to inspect the zone as soon as it forms. By neglecting to take these precautions the zone will appear heavier and denser than it otherwise would, consequently leading the observer to overestimate the amount of albumin present. The general rules are that the faintest zone that can be seen indicates one twelfth per cent by weight of albumin. On looking vertically downward one can see the bottom of the glass through any zone where there is less than one per cent of albumin. If the zone is too dense to be seen through, there is present one per cent or over. In cases where there exists a great amount of albumin—i. e., two to five per cent (the latter amount being the greatest per cent possible)—the zone is not only very dense and thick, but it very quickly tends to lose its defined borders, and to present a curdy appearance. The amount of albumin between two and five per cent can not be calculated by the eye; but as cases very rarely get beyond two per cent, this is not important. When this method is mastered by practice, small variations in percentage can be accurately reckoned, and such conclusions verified by filtering out, drying, and weighing the albumin in a given amount of the urine.

The objections to be urged against this method are that it requires considerable practice before one can be accurate; and to facilitate matters the beginner ought to have the help of an expert, as it is impossible to give an exact written statement by following which accuracy can be assured. A good way, however, to perfect one's self (and this can be done without a teacher) is to observe carefully a zone, and then by precipitation, drying, etc., to verify matters by actually weighing the albumin. If one will take this trouble the method can soon be mastered, and then its value to a busy man will readily be seen, for the presence and amount

of albumin can be determined at a glance. Hereafter in this article, where percentage of albumin is mentioned, that by weight is intended. Much has been written lately in support of the theory that a small amount of albumin (that is, in the neighborhood of one twelfth per cent) can appear from time to time in the urine from mere physiological and not pathological causes. Such statements should, however, be taken with suspicion. It is safe to say that when albumin to the amount of one fifth to one fourth per cent exists in urine, blood and pus being absent, its source is from the kidney. This fact ought to be verified by microscopical examination of the sediment, and it can be in almost all cases if time and patience are employed.

Small traces of albumin, blood and pus being absent, usually have their source from the kidney, but may arise from certain conditions of the prostatic or seminal organs. In these latter conditions the microscope reveals considerable quantities of prostatic, vesicular, or seminal fluid. In some cases a small amount of albumin is found in the urine secreted during exercise, while in that secreted during sleep, or perfect quiet, none appears. Such individuals are usually in perfect apparent health, and probably have had their attention first drawn to the presence of albumin on applying for life insurance. This condition may be accounted for by the fact that a little gritty or calculous material, or perhaps a cyst, exists in the kidney, which exercise stirs up, slightly congesting the immediately surrounding renal tissue.

Some drugs which act as irritants to the kidneys frequently cause a little albumin to appear when given in physiological doses. When taken in poisonous doses, much albumin with suppression results. This applies to such drugs as phosphorus, cantharides, turpentine, and the like. In sharp fevers, especially in scarlet, typhoid, and the septic fevers, it is customary to find some albumin; also in passive congestive conditions of the circulation, such as exists in pregnancy, some tumors, portal, cardiac, or pulmonary obstruction, etc. In most of these preceding conditions the presence of albumin is temporary, dependent on something that has its location outside of the kidneys, the albumin disappearing together with the outside cause.

Then, again, albumin exists in the urine as a result of disease located in the kidneys themselves. In such condition the percentage of albumin is to some extent a differential diagnostic feature. A large amount, generally one per cent or over, is usual in the early stages of acute nephritis, and throughout the course of chronic parenchymatous nephritis, where degenerative changes take place in the kidney-secreting cells, usually of a fatty character. In amyloid degeneration and early tubercular invasion, in gouty kidney, and in the early stages of chronic interstitial nephritis (contracted kidney), one expects a consider-

able amount of albumin, usually from one fourth to one per cent, according to the extent and involvement of the disease.

In the convalescence of acute nephritis the albumin gradually decreases and disappears with complete resolution. A very small amount of albumin—so little, in fact, that it often escapes the observation of a careless examiner—frequently occurs in the later stages of contracted kidney. I have in mind two such instances where practitioners of good repute, judging from examinations of the urine only, the patients never having been seen by them, sent written opinions to sufferers bedridden by this slow and fatal disease, stating that no disease of the kidneys existed. In both these cases death from uræmia followed in a few months. If this form of disease be watched, however, exacerbations will be found rather frequently where as much as one fourth or one fifth per cent of albumin is present. At those times also the microscope finds many confirmatory evidences of disease which are very few and far between in the intervals where the albumin largely disappears. This is the disease in which mention has been made of the low specific gravity and great increase in volume of the urine. In this form of trouble general arterio-capillary fibrosis co-exists with the consequent hypertrophy of the heart. If in such cases one uses a delicate test, such as Millard's, the albumin is readily detected. In conditions of hydronephrosis a small amount of albumin, often only a trace, exists, probably due to a low-grade inflammatory condition set up in the secreting tubules owing to the pressure of the confined fluid. If this pressure is suddenly taken off, much albumin and active inflammatory changes usually ensue. Such conditions exist in connection with the sudden relief of retention of urine, more especially with reference to old men suffering with prostatic obstruction, where the increase in the amount of residual urine, with the accompanying dilatation of the ureters and pelves of the kidneys, has been a matter of considerable time.

In elderly individuals where there are extensive atheromatous changes a trace of albumin usually occurs. Such cases as a rule do not do well after operation or instrumental interference in connection with the urinary organs, probably owing to the fact that the kidneys are prevented by these changes from adapting themselves to altered conditions.

Albumin is also to be considered when associated with pus, no blood being present. When pus exists in the urine, albumin is necessarily there also in some amount. In vesical catarrhs where the urine is acid, as is the case with a smooth, hard calculus, or with prostatic obstruction without much tenesmus, also in cases where gonorrhœa has extended to the neck of the bladder, considerable free pus may be present, but the amount of albumin in a filtered specimen is not great, usually about one fifth to one sixth per cent, or less. This rule also holds for tubercular

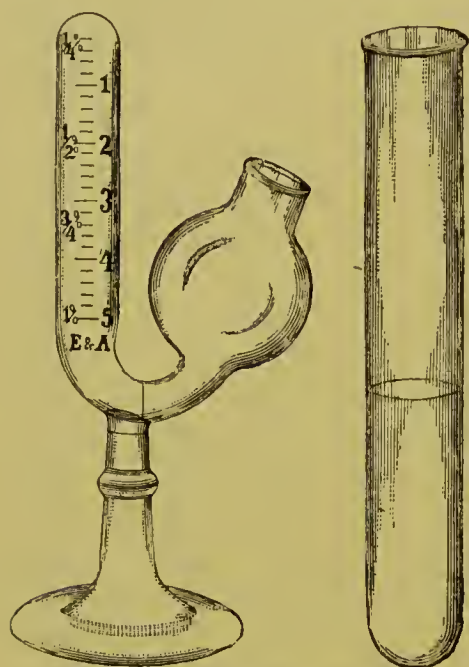
affections confined to this region before ulcerative changes with great tenesmus have taken place. In this last condition, however, much albumin may be expected, probably due to blood serum. The same is the case sometimes in old men with severely inflamed prostates where there is great tenesmus. In such conditions over one per cent of albumin may exist with the pus, making the surgeon fear considerable kidney involvement. Still, speedily after the tenesmus has been relieved by a suprapubic incision, the albumin often almost wholly disappears, and no involvement of the kidneys can be traced. Aside from these instances, however, where from one half to one per cent of albumin exists in a filtered acid specimen of urine, involvement of the pelvis of the kidney in the inflammatory process may be suspected. In decomposed urine containing pus, little can be inferred from the albumin tests, as under such conditions they are, as has been explained, unsatisfactory. Where blood to any extent is present in the urine, either by itself or associated with pus, the tests for albumin are of little or no significance, as it is always present in abundance, owing to the blood serum.

Sugar.—Sugar in the urine is always pathological and indicative of a diabetic condition. This important pathological state can not be positively diagnosed except by the chemical demonstration of the presence of grape-sugar in the urine. Not only is the chemical demonstration of the presence of sugar important, but also the quantitative estimation, for by this latter procedure both the severity of the disease can be noted, and also the modifications and results which dietetic, therapeutic, and hygienic measures are able to effect. The test recommended for the detection of sugar is a modification of Fehling's test with cupric sulphate. The trouble with Fehling's cupric sulphate solution is that it is unstable. The modification test to be described was recommended to the writer several years ago by Dr. Keyes, who states that he first adopted it on the strength of an indorsement which appeared in one of the New York medical journals. Search has been made for this article in order to introduce its author, but without success. This test is very reliable in all cases where sugar is present to any considerable extent. For small traces it is well to confirm the results of this test by the fermentation test or by the polariscope. The three reagents necessary for the copper test to be described are (1) a solution of cupric-sulphate, grains xl, in pure glycerin, ℥ j (this is perfectly stable, care being taken to have the glycerin pure), (2) liquor potassæ, (3) tartaric acid. Into a test-tube pour a drachm to a drachm and a half of the liquor potassæ. Into this liquid in the test-tube drop three or four grains of the tartaric acid, reckoned in a rough way on a knife-blade. Heat the fluid in the tube to boiling over a Bunsen or alcohol flame. To this add six to ten drops of the glycerin and cupric-sulphate solution. Shake and heat a little more. The fluid in the tube is now a

deep robin's-egg blue. To this fluid add the suspected urine, a few drops at a time, shaking and heating between each addition of drops until about half as much urine in volume as there was blue fluid has been added. If sugar is present in a larger quantity than a trace, an ochre-yellow, with sometimes reddish and sometimes grayish tinges, appears in the form of a precipitate. If much sugar is present, the addition of the first two or three drops of urine to the blue solution will demonstrate the reaction very clearly; if but little sugar is present, then the larger amount of urine must be added. The colors in the end reactions by this test are exactly similar to those obtained by the tests with Fehling's solution. Sometimes uric acid and allied substances which have not been thoroughly oxidized into urea act as reducing agents on the copper solution, changing the color from blue to reddish, no precipitate usually being found. In such in-

stances by this test alone the presence of a trace of sugar can not be determined, and another test is resorted to for confirmation.

Fermentation Test.—This test is based on the fact that the yeast-fungus acting on solutions of grape-sugar causes their decomposition into alcohol and carbonic-acid gas, one equivalent of grape-sugar being decomposed into two equivalents of alcohol and four of carbonic-acid gas. Dr. Max Einhorn, of New York, has rendered this test very practicable by means of his tubes, which are manufactured by Eimer and Amend, with directions for use. The cut representing the tubes and the directions sold with it, which seem explicit, are embodied here. There



Fermentation Saccharometer.

is one important statement to make in regard to this test, and that is, never to use dry yeast-cake. Of the wet compressed cakes, Fleischmann's have been used, and have given accurate results.

Directions.—Take one sixteenth of a cake of Fleischmann's yeast, shake thoroughly in the graduated test-tube with ten cubic centimetres of the urine to be examined. Then pour the mixture into the bulb of the saccharometer. By inclining the apparatus the mixture will easily flow into the cylinder, thereby forcing out the air. Owing to the atmospheric pressure, the fluid does not flow back, but remains there.

The apparatus is to be left undisturbed for twenty to twenty-four hours in a room of ordinary temperature.

If the urine contains sugar, the alcoholic fermentation begins in about twenty to thirty minutes. The evolved carbonic-acid gas gathers at the top of the cylinder, forcing the fluid back into the bulb.

On the following day the upper part of the cylinder is filled with carbonic-acid gas. The changed level of the fluid in the cylinder shows that the reaction has taken place, and indicates by the numbers—to which it corresponds—the approximate quantity of sugar present.

If the urine contains more than one per cent of sugar, it must be diluted with water before being tested.

Diabetic urines of straw-color, and a specific gravity of 1,018–1,022, may be diluted twice; of 1,022–1,028, five times; 1,028–1,038, ten times. The original (not diluted) urine contains in proportion to the dilution two, five, or ten times more sugar than the diluted urine.

In carrying out the fermentation test, it is always advisable to take, besides the urine to be tested, a normal one, and to make the same fermentation with it. The mixture of the normal urine with yeast will have on the following day only a small bubble on the top of the cylinder. That proves at once the efficiency and purity of the yeast. If there is likewise in the suspected urine a small bubble on the top of the cylinder, then *no* sugar is present; but if there is a much larger gas volume, then we are *sure* that the urine contains sugar.

If the percentage of sugar in a mixed specimen of the urine passed in twenty-four hours is known, together with the number of ounces secreted during that time, the exact number of grains of sugar in the urine can be most easily calculated.

The *quantitative estimation of sugar*, together with the demonstration of its presence can be quite accurately obtained by means of the polariscope. Théodore and A. Duboseq, of Paris, manufacture a beautiful instrument for this purpose. The expense of this instrument, however, stands in the way of making this method popular, and as the simple fermentation method just described seems to answer the purpose very well, it has not seemed judicious to take up space here to explain the steps necessary in connection with the use of the polariscope.

The appearance of sugar in the urine is associated with the nervous centers, and has nothing to do with the actual condition of the kidneys, though frequently in cases where much sugar is habitually secreted there is found a little albumin and a stray hyaline cast in the urine, probably indicative of a slight inflammatory or congested condition set up in the kidneys by the passage through them of sugar. A small amount of sugar often appears temporarily during dietetic and venous excesses in highly nervous individuals. A little less commonly a mental or nervous strain not associated with any excess may cause it to appear. In this latter class of individuals often uric-acid and calcic-oxalate crystals and sometimes

spermatozoa, appear at such times associated with the sugar. In some individuals simply an excess of saccharine food, with no accompanying nervous tension, will cause sugar to appear. In such cases the prognosis is not so good as in the former class. Then, again, there are the confirmed diabetics, in whom no dietetic *régime*, together with nervines and climatic changes, can cause an entire disappearance of the sugar except possibly for a short and very occasional interval. It is in these cases that the quantitative estimations are important in calculating the effect of the different methods employed to insure relief, as it is impossible frequently to judge accurately of the condition of these individuals by their symptoms or by their statements.

3. ORGANIZED SEDIMENTS.

The study of organized sediments is accomplished by the eye, aided in large measure by the microscope, together with certain surgical procedures, chemistry playing a very minor part. This subject will be subdivided as follows: epithelia, prostatic fluid, seminal and vesicular fluid, mucus, casts, pus, and blood. Any of the rare conditions which are not included in these subdivisions will be treated in the final chapter, under Miscellany.

Epithelia.—Epithelial cells from different parts of the urinary tract differ in one or more of the three following particulars—namely, size, shape, and structure. The same statement can be made to apply to a considerable extent to the different layers of epithelia from the same region according as the cell is new, signifying from a deep layer; or old, signifying from an outside layer. One has rarely to consider the layer of the epithelial cell except in inflammatory conditions at the pelvis of the kidney or the bladder. In some cases the location of inflammatory disturbances can be definitely determined by the nature of the epithelia found in the urinary sediment along with the inflammatory exudations, and in all cases valuable hints as to the source of the inflammation may be obtained from the study of the epithelia even though the cells may not be characteristic enough to admit of definitely locating the trouble. Anterior urethral epithelia are not very important in diagnosing inflammations in that region, since it is rarely necessary to have recourse to the microscope as an aid, the discharge from the meatus of itself furnishing all the evidence that is usually necessary, the exact location being determined by the endoscope. Under the microscope these cells usually appear spindle-shaped or oval, sometimes irregularly rectangular, and occasionally caudate. The nucleus is large and very distinct. The cells themselves are rather large, and their structure is firm and compact. They are well seen in beginning convalescence from an acute urethritis entangled together with pus-corpuscles in the stringy mucus when one of the fine urethral shreds is

taken from the urine and placed under the microscope. These cells can be confounded with those from the deep urethra. The only difference is, that those from the deep urethra are proportionately more inclined to the oval shape, quite a number of them being almost round. It is common for them to be associated in inflammatory conditions with prostatic fluid, and thus their source can frequently be verified.

The typical bladder-cell is quite large. It has a generally round or rectangular shape, with irregular, roughened edges. Frequently several of these pavement-cells are seen attached, their irregular lines of union being plainly visible. These cells are much lighter in structure than those from the urethra. They are from the outer epithelial layer of the bladder, and are consequently the most matured. In the region of the neck of the bladder there is a gradual blending of cell characteristics; in that part of the neck nearest the deep urethra the cells resemble to a considerable degree their neighbors in the deep urethra, this resemblance growing less and less, and the bladder characteristics becoming more and more marked on the passage backward to the bladder proper. Caudate and spindle-shaped epithelial cells from the bladder wall come from the median epithelial layers. These cells are lighter in structure than the urethral cells, and their nuclei are not so distinct. They resemble much, and can not be well distinguished from, the cells from the ureters and the cells from the external epithelial layer of the pelvis of the kidney. These caudate and spindle-shaped cells from the median epithelial layers of the bladder are not frequently seen in large numbers, except occasionally in cases of some hard, smooth vesical calculi, which cause a constant moderate friction on the bladder walls, consequently scraping off the epithelium before it reaches the last stage in its development. These cells are not found in cases where calculi set up severe grades of inflammation.

In severe vesical inflammations cells from the deep vesical layers of epithelium appear in the urine, associated with much pus. These cells are oval or round, resembling in a marked degree cells from the neck of the bladder, the distinction being that the average size of the deep-layer vesical cells is smaller and the structure lighter than that of the cells from the neck.

The deep-layer vesical cells may also be confounded with the cells from the deeper layers of the pelvis of the kidney. Here, again, the distinction is that the pelvic cells average somewhat smaller in size and are lighter in structure than the deep vesical. Cells from the ureter are rarely seen in the urine except immediately following a sharp passage of gravel or a small calculus down the ureter, in which case a little blood and pus are associated in the sediment with the cells. These cells, as has been stated, are customarily caudate or spindle-shaped. They resemble very closely the outer-layer pelvic cells and the middle-layer

bladder-cells. The cells from the outer layer of the pelvis of the kidney appear in the urine only after some acute inflammatory disturbance in that region, such as may be set up by calculous irritation or acute congestion from cold, etc. They bear so close a resemblance to ureteral cells that a differential diagnosis can not be made. The cells from the deeper layer of the pelvis of the kidney and from the large, straight tubules of the kidney are identical, and are important in diagnosing chronic inflammatory conditions of that part. The practiced eye can in most cases positively identify them under the microscope. Dr. Heitzman, of this city, has, more than any one else, called special attention to these cells. They are round in outline. Many of them, however, have the least bit of an attempt at a caudate extremity, which can be seen only by careful observation, and which bears about the same relation to the cell proper that the stem bears to the apple. These cells are about one third larger than a natural pus-cell. They are most delicate and light in construction, and under the slide of the microscope they seem to float about more readily than the associated pus-cells. They are so delicate that they soon disintegrate, in which condition they can not be distinguished from pus-cells that have absorbed much fluid. It is therefore necessary, in looking for them, to examine a rather freshly passed urine in order not to risk disappointment. These cells frequently seem to have several nuclei, as do pus-cells. Cells from the vesical neck, and from its deep epithelial layers, may be confounded with the cells under consideration. These vesical cells, however, average larger and are much denser in structure. Cells from the small tubes of the kidney are almost exactly like pus-cells, except that they have no visible nuclei. They can therefore but rarely be differentiated from pus-cells, except when they appear adherent to casts. They are consequently by themselves of little diagnostic importance.

Vaginal epithelium resembles in a marked degree that from the outer vesical layers. The vaginal cells are almost always irregularly rectangular in shape, showing a great tendency to appear segmented together in groups. When one sees in a sediment a great number of such cells and very little pus, indicative of existing inflammation, the presumption is very strong that the cells are vaginal and not vesical. These cells appear in great numbers in the normal vaginal secretions, consequently they easily and naturally become mixed with the urine as it is voided. They often serve to confuse the microscopist. It is always well, therefore, to direct women patients to carefully donche themselves before voiding the specimen to be examined. Occasionally heterologous cells are found, indicative of some foreign growth.

Prostatic Fluid.—This fluid, when present to any extent in the urine, is visible to the naked eye, floating about as a viscid, quite transparent,

stringy mass. When clear it is usually of a light specific gravity, and consequently remains generally near the surface of the urine. It appears as a white, clumpy, opaque mass when pus-corpuscles are intermixed, as occurs in inflamed conditions of that part. Under the microscope the fluid itself presents a finely striated appearance, and in this mesh-work are seen the prostatic epithelial cells, which are rounded or oblong, closely resembling those already described from the deep urethra. Associated with these cells in the fluid one often sees irregularly shaped, smooth, rather highly refractive amylaceous bodies called symplexions. With our present knowledge no special diagnostic significance is attached to these bodies. Prostatic fluid in the urine not associated with pus points to over-activity of the gland. This condition is often observed in individuals addicted to sexual irregularities and excesses, a morbid sensitiveness of the gland being produced. It also occurs in highly nervous individuals as a result of mental and nervous strain due to overwork. Urethral stricture sometimes causes it, owing to the congestion of the parts behind the stricture; also rectal and vesical troubles which occasion much spasm of those parts. During or following an active inflammation of the deep urethra, such as occurs often in gonorrhœa, the prostatic follicles are involved, and then an abundant flow of prostatic fluid, associated with pus, results.

Vesicular and Seminal Fluid.—Seminal fluid is gradually collected in the vesicles, thence to be ejaculated as occasion requires. Consequently, seminal fluid when found in the urine is associated to a greater or less extent with vesicular secretions. In normal conditions of the vesicles, however, the amount of fluid generated in them is very slight, and consists of a little mucus and a few desquamative cells not to be distinguished from prostatic cells. In normal urine neither this nor seminal fluid is found, except in the urine first voided after sexual intercourse. When the seminal vesicles are inflamed, they secrete a mucus which is thick, glairy, and abundant, looking much like prostatic fluid. In fact, it could not be distinguished from prostatic fluid were it not for the presence in it of spermatozoa, due to the admixture of seminal fluid. In this vesicular fluid, secreted in inflamed conditions of the glands, a considerable number of epithelial and pus cells are intermingled, the greater the inflammation the greater the number of the cells. It is important from a diagnostic point of view, in case spermatozoa are found in the urine, to determine whether they are associated with an abnormal amount of vesicular fluid or not. If they are associated with this pathological vesicular fluid, the diagnosis points to vesiculitis; if they are not so associated, the diagnosis points to spermatorrhœa—two distinct diseases, which differ much in prognosis and treatment. Pure seminal fluid is hardly a urinary sediment, and so will not be further considered here. If one

suspects vesiculitis, and has trouble in finding evidence of it in the urine examined, it will be of advantage sometimes to examine a specimen voided after or during the passage of a large stool, or after digital pressure on those parts per rectum. Occasionally the spermatic cord connecting with the corresponding vesicle becomes impervious, as after gonorrhœal or tubercular inflammations of that region, in which case, should vesiculitis occur, no spermatozoa would appear in the sediment in connection with the vesicular fluid, and the fluid would probably be mistaken for prostatic fluid. In such a case the diagnosis would have to be made by means of surgical explorations

Mucus from the urinary tract is rarely important from a diagnostic point of view. It is always increased during inflammations, and often it is seen as quite a clond in urines where there have been active inflammations, the pus largely disappearing before the mucus. In the urine from a bladder where there is much inflammation, together with putrefactive changes, the mucus, on standing, becomes as it were coagulated, gluing the sediment together into an elastic, gummy mass.

Casts are molds formed of exudative inflammatory material in the secreting tubes, generally of the kidney, rarely of the prostate. This exudative material, pure and simple, is a hyaline substance, translucent and sometimes semi-transparent, easily molded, but at the same time of enough consistency to preserve its molded form in the urine. Hyaline material, which makes up the body proper of the cast, frequently is so stained by or mixed with blood, blood-pigment, and degenerative material, such as fat, epithelium, etc., that its hyaline characteristics are to a great degree or wholly masked. According to these different appearances, casts are classed as hyaline, waxy, blood, brown granular, coarsely granular, finely granular, fatty, and epithelial.

A waxy cast is a pure hyaline cast of dense structure and with little transparency. A blood-cast is one with adherent blood-corpuscles. A brown granular is one stained with blood-pigment. Coarsely granular and finely granular casts are those mixed with amyloid degenerative material of varying degrees of fineness. Fatty and epithelial casts, as their names imply, are those covered respectively with fat-globules and epithelial cells. A fat-globule on a cast is distinguished from a speck of granular material by its marked refractive properties.

Casts vary in caliber according to the size of the tubes in which they are molded; consequently casts from the straight tubes of the kidneys are larger than those from the convoluted tubes. In children they are naturally all small; and in an adult, where the casts are all of small caliber, a contracted kidney is suspected. In diseases of the kidney, pure hyaline casts are found in convalescence from acute nephritis, in passive congestion, and in many chronic diseased conditions of these organs in

the absence of acute exacerbations. Hyaline casts are liable to present a waxy appearance in amyloid disease of the kidney, and in other diseases of the kidney when the vitality of the individual is low. Blood-casts appear in acute nephritis, in calculous nephritis, due to the wounding of a blood-vessel, and after injuries from the same cause. They also occur occasionally in acute exacerbations of a chronic disease. Brown granular casts often appear with, and usually persist after, the disappearance of the blood-casts. They would also appear in any individual with kidney disease whose red blood-corpuscles are undergoing rapid degeneration, as occurs at times in scurvy, typhoid, etc. Coarsely and finely granular casts are found in the commencement of convalescence from acute nephritis, and in chronic conditions generally, where the disease shows some activity. Fatty casts are found in chronic parenchymatous nephritis, usually associated with much albumin, and, when abundant, are indicative of a serious state of disease. An occasional epithelial cell often adheres to a cast as it slips out of its tube. It is only when very many of these are found adhering to a cast that it is called epithelial. In acute nephritis following scarlet fever such casts are numerous, as the name "desquamative nephritis," often applied, would signify. In order to find casts, urine should be allowed to stand for several hours, and then the fluid for examination should be taken by the pipette from the bottom or very near the bottom of the glass.

If, from the presence of albumin, casts are suspected, many slides should be examined before a negative opinion is given. Sometimes, in cases of chronic interstitial nephritis, for instance, the finding of a cast is extremely difficult, because not only few casts are present, but also, owing to the great transparency of those present, detection is difficult even when in the field of the microscope. In such cases the finding may be facilitated by staining the fluid slightly with a dye like methyl violet, which color is quite readily taken up by the hyaline material. The demonstration of disease involving kidney-tissue to any extent is never perfect until casts have been found.

Casts are cylindrical in shape. The parallel sides and the well-defined ends should be carefully focused under the microscope, and determined before a positive opinion is advanced; for many times, if this is not done, a roll of stringy mucus may deceive one who is not very expert. In the case of the mucous roll, however, the sides will rarely be found to be parallel except perhaps for a short distance, and one or both ends will be found, under careful observation, to be spun out into a fine, wavy tendril. Prostatic casts are occasionally seen. These casts are generally finely granular, some nearly hyaline, and taken by themselves they can not often be distinguished from kidney-casts. They, however, rarely exist alone, floating freely about, as is usually the case with kidney-casts, but

are found imbedded in a mass of prostatic fluid. The urine also has no albumin, unless it be a trace revealed by a delicate test, due to the prostatic material present. These prostatic casts may apparently occur in the case of any prostate where a moderately inflamed or congested condition has persisted for some time.

Pus.—Pus is found in the urine as a result of inflammation in connection with the urinary tract. It is easily detected by the eye when it is present in any quantity. When it is in great abundance, the urine resembles gruel. When there is but little, the urine simply loses its clear, transparent appearance, and, instead of looking like sherry, as it should, it resembles cider. The eye frequently can not differentiate between pus and earthy phosphates or urates, and chemical measures have to be resorted to in order to determine this point. These measures, however, have been already described in connection with the consideration of earthy phosphates and urates, and so need not be referred to again.

Bacteria also may be confounded with pus, and this question must be settled by the microscope. Of course, when bacteria are present in freshly voided urine, inflammation to a greater or less extent must of necessity exist in the urinary tract, and as a result pus must also be present in quantity proportionate to the existing inflammation. In some chronic conditions, where the bacteria have been present for a long time, the results of the acute inflammation set up when the bacteria were first introduced may have largely passed away, leaving a low-grade chronic inflammation behind, in which condition the urine may be loaded with bacteria and yet contain but little pus. Such a state of affairs is rather frequent in the case of old men long habituated to catheter life, where great nicety with reference to cleanliness has not been observed. In the majority of these bacteria cases, however, the pus is present in amount sufficient to mask the bacteria except where the microscope is employed.

After the presence of pus in the urine is established, the main point to be determined is the source of the pus. To accomplish this, both inspection, aided by the microscope, and surgical methods, are employed. Only a few observers claim by the microscopical study of the pus-cells themselves to be able to determine their source; for, of course, all pus-cells are much alike, and whatever differences they may have seem to depend on their stage of development and on processes of disintegration which set in after death rather than on their source. It is, however, on the sediment which is found in connection with the pus that opinions as to its source are usually based. Thus, if one finds epithelium from the pelvis of the kidney in considerable amount along with the pus, it is proper to infer that the pelvis of the kidney is the seat of disease. So, likewise, if casts are found, the kidneys are considered; if vesical epithelium, the bladder, etc.

There are a few points which it is well to mention here with reference to the general appearance of pus. Some of these points have been already referred to in the consideration of acidity and transparency. Very often pus from the pelvis of the kidney settles in a compact, firm mass, leaving a quite clear if not perfectly clear fluid above. If, now, the vessel is agitated, the pus is easily stirred up again, rendering the fluid turbid and homogeneous in appearance, showing that the settled mass had little or no adhesive qualities. The pus in such urines is apt to preserve these qualities for a considerable time, owing, probably, as has been observed, to the persistence of the acidity in these cases. Pus from the bladder region generally does not settle well. In most cases of moderate vesical inflammation it appears at the bottom of the glass, after standing, as a very loose, flocculent mass, taking up considerable space, and having an irregular, wavy outline to its upper border. In some cases the upper border of this sediment can not be well defined, it being impossible to detect where clear urine commences. When, however, no clear upper space appears on standing, bacteria are associated with the pus. Then, again, if these urines after standing a time are agitated, the sediment is not likely to be readily stirred up, owing to adhesive qualities which have been developed. In such instances, if the fluid is vigorously agitated, the sediment leaves the bottom bodily in a twisted,ropy mass. This adhesive quality is probably due to fermentative changes, which set in promptly, as a rule, in cases of vesical inflammation.

The surgical methods employed in detecting the source of pus are as follows: If the source is from the anterior urethra, pus appears at the meatus to a greater or less extent as a continuous flow. In such conditions, if the flow is slight, stroking the urethra from behind forward will bring some pus to the meatus. If the source of pus is from the deep urethra, there may be no flow of pus forward at all, the meatus being perfectly dry. In such cases, however, there is liable to be at irregular intervals, probably due to spasmodic contraction of an expulsive nature, some pus at the meatus. In cases of urethral inflammation, in fact, as a preliminary step in the investigation of all inflammations of the urinary tract, the patient, the bladder being fairly distended, should be directed to pass his urine in two parts as equally divided as possible. By this means the washings of the anterior urethra are all in the first specimen. If there is active inflammation of the deep urethra the products of that inflammation by natural muscular action flows backward into the bladder. In this condition of affairs the second specimen of urine is just as turbid as the first.

In some chronic conditions of the deep urethra where there is little free pus, clumps of prostatic material and shreds containing pus are all that is present to mark the inflammation. Frequently these clumps and

shreds adhere to a certain extent to the deep urethra, and are not pressed back into the bladder by the natural muscular contraction, and consequently appear in the first flow of urine, the second remaining clear. Sometimes—and this occurs occasionally in prostatic inflammations—the greatest turbidity of the urine will be in the last half-ounce passed, the muscular spasm becoming more violent as the vesical walls contract on an empty bladder, giving the inflamed and congested prostate a squeeze, thus setting free an extra amount of the products of inflammation. This condition of affairs must be distinguished from the following one, and it can easily be done by the absence of vesical irritability and spasm in the condition to be considered. In some cases of pyelitis, or vesical atony, urine, loaded with pus, collects in a non-irritable bladder, and if the individual is not active the pus settles largely at the bottom. Consequently, the first urine passed may be quite clear, the latter portion being very muddy. This condition of affairs is seen in elderly men who have prostatic enlargement, which causes the urethral outlet to be somewhat above the normal level. It can never exist in the young subject, where the urethral outlet is at the most dependent portion of the bladder. When the second specimen contains pus the deep urethra, together with the vesical neck, the bladder proper, and the kidney region have to be taken into consideration. Usually the deep urethral region can be ruled out as the seat of trouble if there is an absence of tenderness in that region, and no blood follows on the passage through it of a good-sized blunt steel sound, or on pressure exerted there by means of the finger in the rectum.

In order to settle the question as to the source of the pus between the kidney region and the bladder, a good procedure is to introduce a soft catheter into the bladder, and through this instrument to wash the cavity perfectly clean, the last washing being poured into a glass in order that its cleanliness can be the better demonstrated. The bladder after the washing should be dry. Then the patient is left for an hour or so, at the end of which time he is directed to pass his urine into a glass, and this is compared with the specimen voided before the washing. If the specimen passed after the washing is much clearer than that previously passed, the evidence is good that the pus comes wholly or in great part from the bladder. If the specimen after the washing is just as turbid as the one before it, then the strong presumption is that the pus comes from the kidney region. This is a very practical and useful test. It is often very necessary to determine whether the pus comes from one or both kidneys, and if from one only, to locate that one positively. This can frequently be done with great nicety by washing the bladder and filling it with clear water and then introducing a cystoscope. By means of this useful instrument the mouths of the ureters can be watched, and the pus can be seen as it is ejected from them. In case the cystoscope is not to be had, the

history of pain and tenderness on one side, together with palpation (better under an anæsthetic), which frequently shows an enlargement of the affected organ, have to be relied on in making the differential diagnosis. Sometimes the pus in the urine does not come from the urinary tract at all, but flows into it through some sinus connecting an abscess cavity. In such a state of affairs, if the sinus makes its entry into the vesical cavity, it can frequently be discovered by the cystoscope, otherwise the diagnosis must be made largely by the exclusion of other conditions.

After pus has been located, its *diagnostic significance* is to be considered. When from the urethra, gonorrhœa or some of its sequelæ, traumatism, and tubercle are the causes usually to be considered; rarely urethral chancre, malignant disease, etc. In diagnosing the first of these troubles and its complications the presence of the gonococcus should be demonstrated. Pus in abundance from the prostate would indicate gonorrhœal infection, tubercle, traumatism (usually due to a calculus lodged in that region, or to instrumentation), seldom malignant disease. A small amount is found at times in prostatic hypertrophy and in some of the neuroses, and after sexual excesses. Pus from the seminal vesicle is usually indicative of a vesiculitis, resulting from gonorrhœa, sexual excesses, the use of tight condoms, or tubercle, rarely malignant disease. Pus from the bladder would lead one ordinarily to consider gonorrhœa (or one of its sequelæ, chiefly stricture), traumatism (occasioned by the presence of a foreign body, or the passage of an instrument, or external violence), tubercle, defective drainage (such as exists in prostatic hypertrophy, atony, and stricture), benign and malignant growths, and bacterial infection. Pus from the kidney region is generally indicative of gonorrhœal infection, calculus, tubercle, defective drainage, inducing hydro-pyonephrosis, traumatism, ascending bacterial infection, abscess (as may occur in pyæmia and low fevers), and occasionally a benign or malignant growth.

Blood can readily be detected by the eye when present in any appreciable amount, owing to the color it imparts to the urine, as has been already considered. Under the microscope the red corpuscles are easily distinguished, and can hardly be confounded with anything else, unless it be very rarely with an extremely unusual and very stray form of calcic oxalate crystal. This condition, on account of its rarity, is hardly worth consideration.

Red corpuscles, which are alive and have amœboid movements, are rarely seen in the urine, as the acidity of the fluid quickly kills them. These corpuscles usually present a round nummular appearance, the disk being evidently rather thicker than the center. In fresh, very acid, and concentrated urines they are apt to present a shriveled, crenated appearance, probably due to the loss of some of their fluid under such conditions

from exosmosis. In very faintly acid and diluted urines the opposite condition is liable to exist, the corpuscles being quite full from endosmosis. When a moderate amount of blood is present in the urine, the microscopical examination of the associated sediment is of value in determining its source, as in the case of pus. When, however, blood is present in abundance, very little idea regarding its source can be derived from the microscope, since the blood is liable to mask the associated deposits in the sediment. Resort, therefore, must often be had to surgical procedures similar in some respects to those adopted with reference to pus. The same procedures, however, which are successes in investigating the source of pus, may be failures in the case of blood, because blood may collect—there being a fresh hæmorrhage—very quickly, while pus collects slowly. Thus, a bladder may be washed free of pus, no matter whence its source, while this can not be done as regards blood during a vesical hæmorrhage. It is very rare for hæmorrhage from the urinary tract to be continuous. It is therefore of importance to watch these cases, and examine under the microscope specimens of urine secreted during the cessation from bleeding, all elements in the sediment being then visible.

Blood appearing at the meatus in the absence of vesical spasms has its source in the anterior urèthra. If the bleeding is from the deep urethra, and is free in amount, it will flow backward and distend the bladder, not appearing at the meatus at all, provided there is an absence of vesical spasm. Such a condition of affairs, however, is very unusual, unless it be directly after the administration of a strong anodyne, for, as a rule, much inflammation attends a free bleeding from the deep urethra, and consequently there is a rapid succession of spasmodic contractions of that part, forcing the blood forward at frequent intervals. Generally in the absence of vesical spasm, probably due to the puckered condition of the deep urethra, the hæmorrhage from that part is very slight. It is usual in hæmorrhages from the deep urethra to find all or the great bulk of the blood in the last half-ounce of urine passed, a few drops of quite clear blood in such instances dropping from the meatus at the very end of the act. This is because of the tight spasm of these parts toward the end of micturition, which does violence to the inflamed surface, thus setting up the bleeding, which in turn is soon checked by the increasing tonic contraction after the act is finished. Then at the next urination, in the first gush of urine, some blood-clots are liable to appear from the source of the preceding hæmorrhage, which again repeats itself at the end of the urinary act. In such a condition, if one attempts to pass a sound through this region great muscular resistance with much pain is encountered. The preceding remarks apply also to prostatic hæmorrhage, except in cases of senile hypertrophy of that organ, in which conditions the

hæmorrhages usually take place directly into the vesical cavity, and will consequently be considered as vesical.

Hæmorrhage from the seminal vesicles is rare, and slight in amount. Its occurrence is demonstrated by bloody seminal emissions. It now remains to distinguish between vesical and kidney hæmorrhages.

Hæmorrhage from the bladder proper, in the absence of existing irritable conditions, frequently does not disturb the functions of that organ or cause pain unless its source involves the vesical neck. Free hæmorrhage from the kidney region is almost always followed by nephritic colic, due to the distention of the pelvis and ureter by blood-clot. Palpation also in such conditions usually shows tenderness and enlargement of the affected organ. In case the hæmorrhage is from the bladder, vesical lavage and instrumentation would in all probability affect it—that is, by increasing the bleeding—except in cases where hæmostatic agents are employed in the lavage, under which circumstances there would be a diminution in the hæmorrhage. Such is not the case if the kidney region is involved. If the hæmorrhage is from the kidney, the bladder can, in a great majority of cases, be washed clean enough so that with the cystoscope the blood flowing from the ureter can be observed. In most bladder cases, by taking advantage of an interval during which there is little or no hæmorrhage, the cystoscope can be used to advantage in the inspection of the cavity, and in the observation of any existing pathological condition. Occasionally, in hæmorrhage from the pelvis of the kidney, the blood-clot as it passes down the ureter will be molded into a long, stringy cylinder, looking like an earth-worm. The moldings are called “ureteral casts,” and are of diagnostic value when observed.

Dr. W. K. Otis, of New York,* speaks highly of a method depending on the resorption of a solution of iodide of potash in determining vesical hæmorrhage. In a case of suspected vesical hæmorrhage the bladder is filled with a solution of iodide of potash; then, after an interval, the saliva is tested for iodide of potash. If this substance is detected by the test, the hæmorrhage is supposed to be vesical in origin; if it is not detected, the source of the hæmorrhage is not vesical, it being considered that no resorption of iodide of potash takes place if the continuity of the vesical mucous membrane is intact.

Prof. Guyon, of Paris, has called attention to the fact that in cases of renal cancer free bleeding often takes place at night during repose, while by day the urine may be comparatively clear. The same author also

* Dr. Otis writes me that the late Dr. T. A. McBride, of New York, in 1885 suggested the idea of this test to him, and that he experimented with it successfully, supposing himself to be the pioneer worker. In 1887, while in Vienna, Otis found Ultzmann using the same test; so the question of authorship is not determined.

states that the blood in these cases usually gives the urine a black rather than a red color.

It is not within the scope of this article to consider in detail the subjective symptoms of patients afflicted with hæmorrhage; a careful study of which, together with the histories, is of great help to the practitioner, aside from the investigation of the urine in making a final diagnosis.

Hæmorrhage from the front urethra would suggest traumatism due to instrumentation, a foreign body, the forcible straightening of the organ in the state of erection, chordee being present, injury during coitus, the injection of irritants, etc.; also gonorrhœa in its acute stage, or a strictured or granular condition resulting from that disease, benign or malignant growths, and tubercular or syphilitic lesions. Hæmorrhage from the deep urethra suggests gonorrhœa or one of its sequelæ (stricture or ulceration), traumatism (generally due to instrumentation, the impaction of a foreign body, or external violence, as from a kick or a fall), tubercle, benign or malignant growths, prostatic hypertrophy in old men, and rarely a reflex spasmodic condition of that region.

Hæmorrhage from the seminal vesicle might indicate gonorrhœal, tubercular, or malignant involvement.

Hæmorrhage from the bladder suggests benign or malignant growths, foreign bodies, tubercle, prostatic hypertrophy associated with atony, the vesical drainage being very defective (in such instances the hæmorrhages usually occurring after the sudden drawing off of much fluid), traumatism from instrumental or outside violence, rarely gonorrhœal ulceration, febrile conditions, syphilis, and parasitic disease.

Hæmorrhage from the ureter may follow violence, as caused by the passage of a calculus.

Hæmorrhage from the kidney region leads one to consider acute general nephritis, calculus disease, traumatism, benign and malignant growths, and tubercle, rarely syphilis, febrile conditions, parasitic disease, etc. Numerous surgeons have reported instances where nephrotomies have been performed for persistent hæmorrhage from a kidney (I myself have seen two such cases in Dr. Keyes's practice), for which no cause could be discovered at the time of the operation. Nevertheless, the operative procedures in such cases generally serve, for some unknown reason, to check all further annoyance from this source.

MISCELLANY.

Bacilli.—A great variety of bacilli are found in urine, but with our present knowledge special diagnostic importance is attached to but two of them, namely, the bacillus of gonorrhœa, commonly known as the gonococcus, and the tubercle bacillus. The gonococcus was discovered by Neisser, of Breslau. Any urethral discharge containing these germs

associated with its pus is considered contagious, and such a discharge has its source from outside contamination. No conditions within the urethra can give rise to a discharge containing them. If, however, these bacilli have been once introduced into the canal, they may remain there a long time in a state of quiescence, as has been shown by the investigations of Prof. Goll and others (*Correspondenzblatt für Schweizer Aerzte*, Basel, April 15, 1891); and while this is the case, they will appear in any discharge which may intervene, no matter how innocent its apparent cause may have been. Many social questions affecting marriage, chastity, etc., depend on the presence or absence of the gonococcus. In fresh cases of gonorrhœa, gonococci are very abundant, and consequently their presence is easily demonstrated. In old chronic conditions, however, oftentimes a long and careful search among the pus-cells of the stray urethral shreds has to be made before the germs are found, or should be made before they are pronounced absent. In order to demonstrate the presence of gonococci, the staining methods recommended in the article on the "Etiology of Urethritis" may be employed in preparing the specimen.

If gonococci are present they will be seen in the affected pus-cell, stained by the methyl violet as little black, cylindrical bodies, always lying together in pairs, parallel and with even ends. Generally quite a colony of these bacilli are grouped together. They are never found outside of pus-cells. They usually involve the lumen of the cell, rarely its nucleus. They colonize certain individual cells, the others being left perfectly free. The percentage of pus-cells affected is very small, even in the most acute stage of gonorrhœa.

Tubercle Bacillus.—This bacillus, when found in urine, is of great importance, as it definitely determines the character of the existing inflammation. In some tubercular conditions, however, it is very difficult to demonstrate the presence of the tubercle bacillus by means of the methods of investigation in use at the present time. If, therefore, tubercular germs are not found in a case of suspected tubercular inflammation, this evidence should be treated simply as negative, and should not be used to exclude a diagnosis of tuberculosis based on physical signs. The tubercle bacillus in urine can not, as in sputa, usually be demonstrated directly in the specimen to be examined, but cultures in gelatin have to be resorted to. This is owing to the fact that but few bacilli are apt to exist in a specimen of urine. It is very difficult to find these bacilli when they are few and scattered. By cultivating them their number is so increased that they are easily recognizable. This process of cultivation requires so much care and skill that it falls to the lot of the bacteriologist rather than the practitioner. For full particulars and directions regarding the tubercle bacillus, reference is made to Friedländer's *Microscopical Technique* (Putnam).

Parasites.—*Filaria Sanguinis Hominis*.—These are the parasites which cause ehyluria; they are consequently of importance in connection with urinary analyses. The urine secreted during the period of activity of these parasites in individuals so affected presents the appearance of milk, or rather cream, with here and there a speck of blood. These parasites are active only when their victim is at rest. Therefore it is in the night urine that ehyluria manifests itself; that passed during the day being quite clear. The microscopical appearance of ehyle is the same as that of milk. Under the microscope the parasites themselves are seen thrashing about, if the specimen is fresh; otherwise motionless and dead. They are sharp-pointed at both ends, and resemble earth-worms in shape. They are about five times as long as spermatozoa. This disease was thought formerly to be confined to the hot countries of the East. Numerous instances of it, however, have been reported in our Southern States, in the West Indies, and in Brazil. Its diagnostic appearance is so marked that it can not be confounded with any other disorder. Dr. W. M. Mastin, of Mobile, Ala., has considered this subject in a very complete and classical article (Annals of Surgery, November, 1888).

Echinococcus cysts are rarely seen in the urine; sometimes, though more rarely, the echinococcus heads and hooks. These cysts vary from the size of a pea to that of a hen's egg. Their source is usually from the kidney, though rarely they find their way into the bladder from a perivesical tumor by means of ulceration.

Bilharzia hæmatobia is a parasite indigenous to sections of Africa, chiefly Egypt, and was first described by Dr. Bilharz, of Cairo. Hæmaturia is associated with the presence of this parasite in the urinary tract.

Bits of tissue from benign and malignant growths are sometimes found in the urine. These bits should be picked out and placed in a drop of glycerin on a glass slide, and gently teased apart and unfolded, so that their structure may be distinguishable under the microscope. Occasionally a positive diagnosis from this procedure alone can be made. This applies especially to villous vesical growths. Very rarely pseudomembranous vesical molds and diphtheritic gangrenous detachments from the bladder appear in the urine. In such conditions inspection aided by the microscope should be relied on to determine the diagnosis. For full consideration of these conditions, reference is made to articles by F. Guyon (Annales des maladies des organes genito-urinaires, Juillet et Août, 1887). Occasionally fecal material and gas may be introduced into the urine through inflammatory action attended by ulceration; so, likewise, necrosed bits of bone, etc. It is well to guard the practitioner against the occasional introduction of foreign material into the urine sent for examination.

URINARY FEVER.

By J. A. FORDYCE, M. D.

THE various terms used by writers to designate the phenomena recognized by surgeons for a long time as sometimes following operations or instrumentation upon the urethra or bladder, indicate in a certain measure the obscure and conflicting views that have been and are yet held regarding their nature. While all authors agree that more than one class of cases, or pathological condition, may be present, a confusion of terms has obscured to some extent a general conception of what is meant by urinary fever. Shock of a mild and severe form, urethral fever, urinary fever, catheter fever, urinary poisoning, uræmic poisoning, urinary infection, are some of the many names given to these disturbances.

The association of micro-organisms with cystitis, often with pyelitis and pyelonephritis, has been recognized for a number of years, and their etiological relationship with these affections pretty definitely established.

In the light of the investigations of the Necker school and others, it is probable that many cases of urinary fever ascribed by the older writers to reflex nervous influence are dependent upon bacterial or ptomaine poisoning, although it is impossible in our present knowledge to ascribe all disturbances which follow operations on the urethra or bladder to an identical cause, to local infection, or to deny absolutely the possibility of a nervous febrile reaction. Septic infection, which differs in no respect from the septic accidents after other surgical operations, follow operations on the urinary organs, or may complicate one of the typical forms of urinary fever, so that it is sometimes difficult to sharply differentiate one form of infection from the other. Still the intimate relationship of the urethra with the bladder and the kidneys, both by continuity of tissue as well as nervous connection, introduces a factor which plays no small part in the development and progress of the malady, furnishing certain conditions which favor, complicate, and follow local infections from the urethra and bladder, and permitting by reflex nervous influence (?) a disturbance in the vascular supply of the kidneys and a resulting disturbance in their functional activity.

Shock.—Immediately following the contact of an instrument with the sensitive urethra, the patient may become faint, lose consciousness for a

few minutes, or have a slight chill or convulsion. As the patient grows accustomed to the introduction of an instrument, the attacks may not be repeated.

It is impossible to explain such attacks, except to call them cases of shock, resulting from an unusual impression made upon the sensitive nerves of the urethra, transmitted to the brain and reflected to the inhibitory nerves of the heart or along the motor nerves. The attacks are quite analogous to shock which results from ordinary surgical injuries, or to the fainting spells which follow an unusual cerebral impression in a sensitive subject. When one keeps in mind the peculiar sexual sensibility of the urethra and its nervous connection with the brain, it is not surprising that such reflex phenomena manifest themselves. Aside from these transient fainting spells, or slight chills or convulsions which are recovered from within a few minutes, a severer form of shock has been recognized in which death has rapidly followed the introduction of a sound or a slight operation on the urethra.

Sir Henry Thompson has met with two cases in which death followed in twenty-four and forty-eight hours after the introduction of a small catheter through a narrow stricture where no visible lesion was produced by the instrument. In one of the cases, in which suppression of urine and death in forty-eight hours took place, the autopsy revealed only highly congested kidneys. The author regarded the fatal issue as the result of suppression of the kidney functions, through some nervous influence transmitted from the urethra.

Mr. Mitchell Banks relates the history of a case in which the passage of a No. 4 metallic bougie through a tight penile stricture was followed by vomiting and rigor within half an hour; a second rigor occurred in two and a half hours, and death in six and a half hours. At the post-mortem no injury was seen in the urethra, and only a slight congestion of the kidneys. A tablespoonful of thick, muddy urine was in the bladder.

Similar cases have been reported by Lister, Velpeau, Fayrer, Harrison, and others. A number of years ago I had the opportunity of closely observing the case of a man aged about forty years in whom a convulsion, coma, and total suppression of urine followed an hour after the passage of a small flexible bougie through a tight stricture of the membranous urethra. Death without a re-establishment of the urinary secretion took place twenty-four hours afterward. There was no elevation of temperature, but for several hours before death a subnormal temperature was found. Although no autopsy was made, it is probable that a previous damaged condition of the kidneys, with insufficiency, was present, otherwise one would not expect death to follow so rapidly from suppression of urine.

Unfortunately, these cases occurred before the importance of a bacteriological examination of the previous condition of the urine or genito-urinary tract was recognized, so that the autopsies made are in a great measure valueless. It has been held that death has taken place too rapidly to be accounted for by an infection, as a longer period of incubation has been looked upon as necessary to such an infection. It is recognized now, however, that the healthy urethra contains micro-organisms which are pathogenic, and that the urethra, which is the seat of an old stricture or other pathological condition, is pretty constantly inhabited by pathogenic germs with their chemical poisons, capable of rapid absorption into the general circulation after an abrasion or other traumatism of the mucous membrane.

Albarran reports in detail the very instructive case of a man forty-three years old, the subject of a traumatic stricture in the bulbous urethra. Following an internal urethrotomy by Guyon without a retention catheter, he was seized, an hour and a half after the operation, with a violent chill. The temperature rose to over 104° Fahr., and the chills were repeated during the day. In the evening, twelve hours after the operation, the patient died with marked asphyxia. At the autopsy ecchymoses were found beneath the capsules of the kidneys; they presented a marked congestion, as did the other viscera.

Behind the urethral stricture pus was found which contained the *bacterium pyogenes*, now thought to be identical with the *bacterium coli commune*, unmixed with other organisms. The same microbe was found some hours after death in the blood, the kidneys, the spleen, and in the urine of the pelvis of the kidneys. There can be little doubt, in view of the dissemination of this organism, that its entrance into the general circulation through the urethral wound was the cause of the patient's death.

Clinically this case is identical with the ones of Thompson, Banks, and others, and without the bacteriological examination could be classed with these as an example of reflex kidney congestion. In this case, however, we must regard the kidney lesions as the result of their attempts to eliminate from the blood these pathogenic microbes or their chemical poisons. Cases are reported in which, almost immediately after the entrance of a sound into the bladder, the patient has been seized with a rigor, followed by collapse and death in a few moments. It would be difficult to account for such a rapid death on any other supposition than as the result of some severe shock. Where to draw the line between these cases of severe shock and the others of rapid septic poisoning is, in our present knowledge, a matter of extreme difficulty.

Although we must recognize the influence of shock, both in its light and grave forms, it is necessary to bear in mind the probability that all

the cases of malignant urinary fever, in which a chill followed by fever and rapid death have occurred, were cases of rapid septic or ptomaine poisoning, and not of reflex suppression of the functions of the kidney from an impression made on the sensitive nerves of the urethra. Clinical evidence, however, strongly favors the view that in a previously diseased kidney, with deficient elimination of excrementitious matter, urethral instrumentation may, by disturbing the normal kidney innervation, precipitate a grave and fatal form of uræmic poisoning without a chill or elevation of temperature.

Symptoms of Urinary Infection.—Clinical observers have recognized several types of urinary infection, which may, according to Guyon, be classified as follows:

1. The acute form (*a*) with a single chill, fever, and sweat; (*b*) one or more repetitions of the acute paroxysm, with remission or intermission in the fever. 2. Chronic urinary fever.

Acute Urethral Fever.—After operative interference with the male or female urethra, or the simple introduction of a catheter into the bladder, the patient may experience within an hour or two symptoms of indefinite character, followed, generally after the first urination, by a chill of varying intensity, and lasting from a few moments to several hours. During

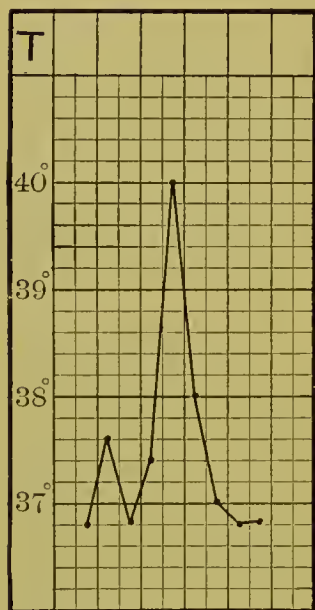


FIG. 1.—Acute urinary fever after internal urethrotomy; recovery. (After Guyon.)

or after the chill a rapid rise of temperature takes place (103° to 106° Fahr.), of somewhat indefinite duration, with severe headache, backache, and rapid action of the heart, attended or followed by profuse perspiration, and ending in an equally rapid decline in the fever. (See Fig. 1.)

Within twenty-four hours, as a rule, the entire paroxysm is over, leaving the patient with only a slight lassitude, which rapidly passes away, with a complete restoration to health. The chill may be so intense and prolonged as to be alarming, the surface cold and cyanotic, and the respirations labored, or of so mild a character as to pass almost unnoticed. The regularity and mutual relationship of the three stages are, according to Guyon, of importance in prognosis.

If the chill is prolonged and out of proportion to the fever and sweat, the prognosis should be reserved, and one should be on the alert for a repetition of the attack.

Quiet or active delirium may be present during the chill or fever. It is not of grave import, and does not materially affect the prognosis.

Nausea, vomiting, or diarrhoea may likewise be encountered. Dyspnoea and cardiac irregularity may, in exceptional instances, be met with.

Instead of a rapid return to the normal condition, as is the rule, the patient may have a recurrence of the paroxysm on the following day, or after three or four days; these paroxysms may be repeated without obvious cause, such as the dilatation of a stricture or the introduction of an

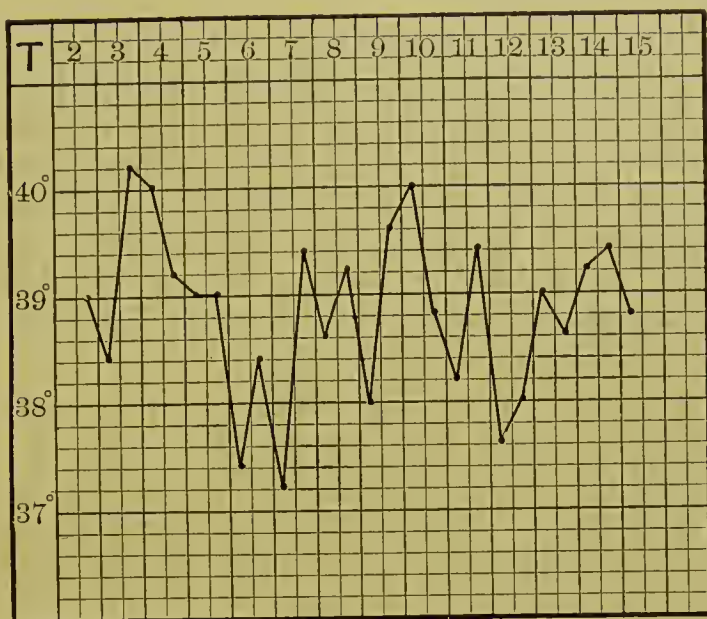


FIG. 2.—Acute recurring urinary fever. Pyelonephritis revealed at autopsy. (After Guyon.)

instrument into the urethra. In case no local lesion can be found to account for the repeated attacks, they may soon disappear, and the patient be left in a normal state of health. (See Fig. 2.)

Thompson has called this variety "acute recurring urinary fever."

Cases are encountered where every attempt made to dilate an irritable or resilient stricture is followed by a chill and febrile paroxysm. On complete division of the stricture these manifestations disappear. It is possible that the free drainage afforded by the complete division of the stricture may account for the disappearance of these attacks. The febrile state may persist with exacerbations and remissions, or may remain more or less constant. When a repetition of the acute attack takes place there is not the same relationship between the three stages—chill, fever, and sweating—as in the frank variety. One of the stages is apt to be exaggerated, while the others may be incompletely developed. With a persistence of the fever the tongue becomes red and dry, and in aggravated cases brown or almost black, and covered with a thick coating, which may involve the pharynx and soft palate. Vomiting and diarrhoea are in certain cases such marked symptoms that some writers have made a distinct type called "choleric form."

Oppression in breathing and cardiac irregularity are more frequently noted than in the first variety of acute urinary fever. Congestion of the base of the lungs, with numerous râles, is often met with.

Contrary to the observations of Morris, Thompson, and others, Guyon has detected neither albumen, blood, nor tube casts in the urine during the attacks; the quantity of urine is diminished only as the result of the fever and perspiration.

This writer has carefully examined his patients with the view of determining the presence of pain in the kidneys. He has found spontaneous pain rare, and pain provoked by pressure over the organs in from one third to one half the cases. The nervous disturbances are similar to those met with in the frank variety of urinary fever. In grave cases the delirium becomes more continuous, and before death the patient passes into a state of coma. While it is the rule for complete recovery to take place in the first variety, death is not so exceptional in this second class of cases.

In certain cases more frequently met with after operative interference on the urethra, certain complications arise which are more closely allied to pyæmia than to true urinary fever. Among these may be mentioned circumscribed induration of the subcutaneous tissue and muscles, with or without abscess formation, pustular skin eruptions, suppuration of the articulations, parotid gland, etc.

The duration of this variety is somewhat indefinite; when death takes place it is seldom delayed longer than twenty days.

Chronic Urinary Fever.—The chronic form of fever may follow the variety just described, from the development of a cystitis, a pyelonephritis, or a general infection. It occurs more frequently as the result of catheterizing an over-distended or atonied bladder in a subject affected with prostatic hypertrophy or an old stricture. In many such cases the bladder contains varying quantities of residual urine, and the kidneys are already the seat of a pyelonephritis or other chronic changes producing renal insufficiency.

This condition of the bladder and kidneys offers a favorable soil for the development of germs introduced by unclean instruments or carried in from the urethra. Independent of interference with the urethra or bladder, these old prostaties, patients with long-standing stricture, calculi, or bladder tumors, may develop irregular chills and fever, or a continuous fever of a mild type (see Fig. 3), in connection with progressive impairment of their strength, loss of appetite, with dry and coated tongue, vomiting, diarrhœa alternating with constipation, headache, a cachectic look, and other symptoms of chronic uræmia.

No fever may be present, or of so mild a type as to be overlooked. When noticed in connection with acute exacerbations or chilly sensa-

tions, it is often attributed to malaria or other influence than its true character.

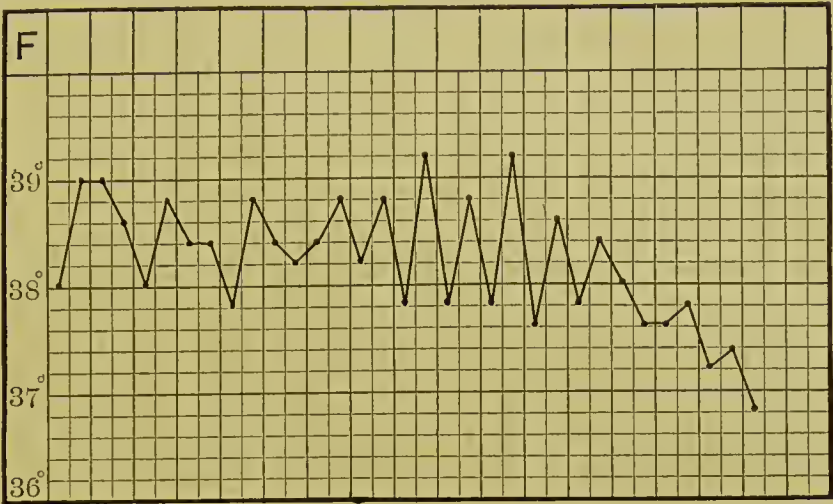


FIG. 3.—Chronic urinary fever. Incomplete retention of urine from prostatic hypertrophy. (After Guyon.)

Guyon has devoted considerable space to the discussion of the dyspeptic symptoms presented by such patients. They readily succumb to operations on the urinary organs, or even to catheterism performed in the most careful manner.

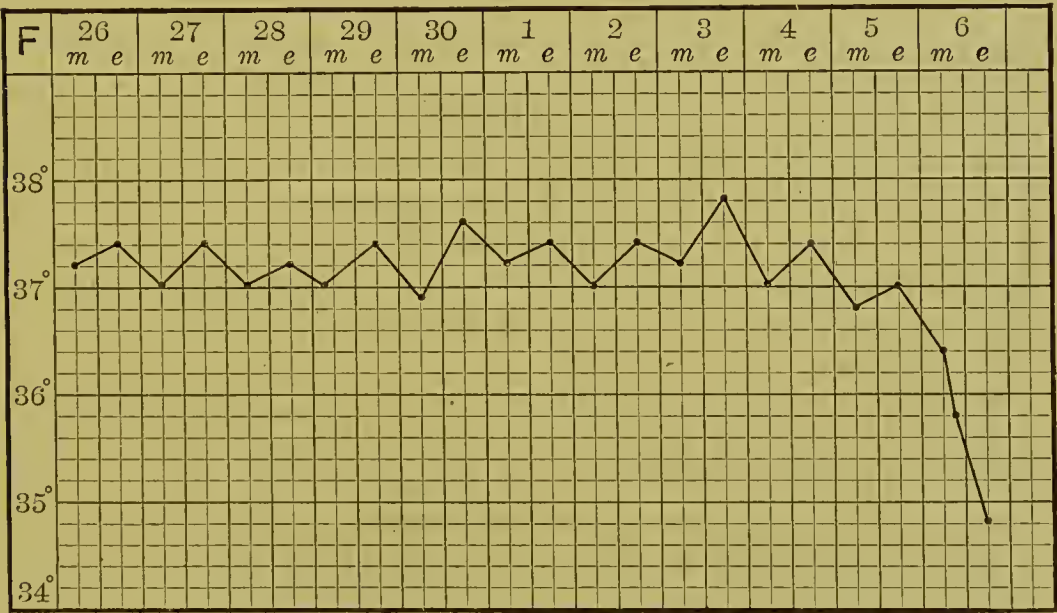


FIG. 4.—Non-febrile urinary cachexia, terminating fatally, with subnormal temperature. (After Guyon.)

If the use of the catheter is begun before the amount of residual urine becomes large—not exceeding twelve to fifteen ounces—it is unusual to find symptoms indicating a local infection. When the amount

of residual urine is larger, with the resulting bladder and kidney changes correspondingly advanced, a cystitis may readily be excited by the use of the catheter, which can produce a general infection with secondary deposits in the kidney, an ascending inflammation of the kidney, or remain confined to the bladder. Such patients may die from pyæmia, septicæmia, or, as is generally the case, from uræmic coma.

In chronic urinary poisoning from obstructive lesions in the urethra or bladder, a cachectic condition may develop in connection with vesical distention and pyelonephritis, in which no fever is present, but where death with a subnormal temperature may follow instrumental interference (see Fig. 4).

Etiology.—The more frequent occurrence of urinary infection in males probably depends upon the fact that they are more often subjected to instrumentation than females. The anatomical structure of the female urethra, while more readily admitting of infection from the vulva or vagina, is less liable to obstructive lesions and urinary stagnation.

A case came under the observation of the writer in which the acute recurring variety of fever was excited by removing a earunele from the female urethra. A nephritis occurred which, after persisting for several months, disappeared, leaving the patient in good health.

The fever which is seen with acute inflammatory affections of the prostate, epididymis, testicle, etc., presents no special characteristics; septic complications may occur which differ in no way from ordinary surgical sepsis. Injuries of the external genitals other than the urethra, although producing shock of a severe kind, are not followed by the chill, fever, and profuse sweating seen in acute urethral fever.

In rupture of the urethra with urinary infiltration, localized destruction of tissue with abscess formation and pyæmia is met with, but no true urethral fever. The same holds true in intraperitoneal and extraperitoneal rupture of the bladder, and in urinary infiltration after suprapubic cystotomy.

Operations on the kidney, followed by the passage of urine mixed with pus and blood over a freshly made wound, do not produce these complications. The observation of these facts has led Bryson to make a distinction between urethral and urinary fever, and to limit the former to the manifestations following urethral instrumentation alone. So many exceptions surround the occurrence of urethral fever that it is difficult to formulate any laws regarding it. It is met with after the most careful operative manœuvre, and absent following prolonged and painful attempts to pass a tight and long-standing stricture.

Some writers have indeed claimed that slight operative interference is more apt to induce urethral fever than more severe injuries. When

all the conditions of the urinary apparatus are taken into consideration, this statement will scarcely hold good.

It may be stated, as a rule, that in cases of long-standing stricture or prostatic hypertrophy, in chronic brain and spinal cord affections, with stagnation of urine, the conditions are more favorable to infection than in more recent urethral troubles with an intact bladder. A bladder whose contractile power is unimpaired can resist the invasion of micro-organisms, and free the urethra of toxic agents, which by remaining might readily excite febrile reaction.

Strictures with tortuous passages and diverticuli afford opportunity for the retention of urine and excellent soil for the growth of micro-organisms. Internal urethrotomy on strictures posterior to the bulb are more likely to be followed by fever than operations on strictures in the pendulous urethra, although exceptions to this rule are met with. After external perineal urethrotomy, the combined internal urethrotomy with perineal drainage (Harrison), and lithotomy with proper bladder drainage, such attacks are rare. Wounds on the floor of the urethra are more frequently followed by these accidents than on the roof. Urethral fever is seldom encountered when proper precautions are taken to prevent contact of the urine with the urethral wound; this especially is true if the urine contains bacteria.

It has been noted by a number of writers, and quite recently by Mr. Harrison, that on removing the drainage-tube after perineal operations or the retention catheter after an internal urethrotomy, the first normal micturition along the canal has been immediately followed by a chill, fever, and sweat. Mr. Harrison, while admitting the influence of micro-organisms in producing the more common forms of urethral fever, is disposed to regard this variety as due to a reaction on the part of the nervous system, and not to a bacterial or toxic infection.

Aside from the presence of bacteria and pus in the urine, certain chemical changes in this fluid are favorable to urinary infection. It is well known that diabetes mellitus predisposes its possessor to local and general septic accidents.

One of the severest cases of urethral fever terminating in recovery which ever came under the observation of the writer occurred in a patient with a long-standing diabetes insipidus. A bulbous bougie, 32 French, was introduced for exploratory purposes as far as the bulb, and was followed by a trifling hæmorrhage only. Shortly after the first urination in the evening a prolonged chill took place, which was repeated during the night, the temperature going up to 105° Fahr. On the following morning a convulsion with rapid and feeble pulse and general cyanosis was followed by a comatose condition, persisting for three days. Irrigation of the urethra with a boric-acid solution during the second day after the

introduction of the bougie was immediately succeeded by a tonic convulsion and a further elevation of the temperature.

It is difficult to resist the belief that some relationship existed between the diabetes insipidus and the phenomena which followed the urethral instrumentation, although the observation of an isolated case will not permit of any generalizations.

The urine which in health is an aseptic fluid in certain infectious diseases contains extractives allied to the toxalbumens and ptomaines capable of producing in animals fever, coma, and apoplexy, followed by death.

Binet has discovered a thermogenic substance in the urine in certain pathological conditions, and in normal urine to a less extent, which causes in guinea-pigs a rise of temperature from 1.8° to 3.6° Fahr.

While many conditions not understood surround the occurrence of urethral fever, it may be stated in a general way that the greater the force used to pass the urethral obstruction and the deeper in the canal it is situated, the more liable are we to produce it.

The presence of cystitis with or without ammoniacal urine, although sometimes benefited by removing the urethral obstruction to free drainage, usually renders its possessor more liable to fever after operations.

All the conditions which produce chronic retention of urine, such as old strictures, prostatic hypertrophy, vesical calculi, and tumors compressing the ureters, are predisposing causes to chronic urinary poisoning. The stagnation of urine by producing changes in the structure and functional activity of the kidneys exposes the patient to the dangers of chronic uræmia if no infection of the urine has occurred, otherwise, to one or more of the septic conditions classed under chronic urinary fever.

Pathogenesis.—The discussion of the theories which have been advanced to account for the occurrence of urinary infection has been entered into at length in the very elaborate and excellent article by Guyon, a brief reference to which can only be made in this article. Velpeau, in 1840, was among the first to attempt to explain its nature by attributing it to the absorption of some of the constituents of urine into the general circulation. Chassaignac believed it to depend upon a phlebitis of the periurethral spongy tissue and of the plexus of the urethro-prostatic veins. Icard, in 1858, upheld this theory of Chassaignac as the general cause of the affection.

Reybard and Bonnet (of Lyons) regarded these accidents as allied to nervous shock. This theory, with some modifications, has been adopted to account for a certain class of urinary fevers by a number of German, English, and French writers, among whom may be mentioned Roser, Morris, Dittel, etc.

While explaining certain exceptional occurrences after urethral and bladder operations, these theories are not sufficiently comprehensive to

account for the general febrile accidents met with. It is admitted that shock of a mild and severe type may occur, and that phlebitis of the urethral veins is an exceptional pathological condition, causing a pyæmia rather than a true urethral fever. A previously diseased state of the kidney, or a passing congestion of these organs interfering with their proper functional activity, caused by a reflex nervous influence having its point of departure in the urethra or bladder, were regarded by Verneuil, Philips, Marx, and others as sufficient to explain the phenomena of urinary fever. On the other hand, Perdrigeon, Civiale, Sédillot de Saint-Germain, Reliquet, and Gosselin, in 1879, believed it to be owing to the absorption of urine from some lesion in the mucous membrane of the bladder or urethra. While clinical evidence sustained the view that urinary absorption was responsible for many of the accidents denominated urethral or urinary fever, the conditions which rendered the urine a bland aseptic fluid in one case and a virulent poison in another were not understood until revealed by modern bacteriological methods.

The toxicity of the urine as the result of imperfect tissue metabolism, from gastro-intestinal absorption of alkaloids resulting from the activity of putrefactive organisms (Bouchard), or from the presence of bacteria or their chemical poisons excreted by the kidneys in certain infectious diseases, may, in exceptional instances, be responsible for certain phenomena connected with urinary fever, or favor its evolution.

The rapidity of the development and intensity of the manifestations of urethral fever in the majority of cases can not be accounted for, however, on the supposition of a previous toxic urine resulting from an elaboration of a ptomaine, except as the result of a local infection of the urethra or bladder.

It is to the Necker school especially that we are indebted for the careful observations and experiments which have established the infectious theory of urethral fever on a scientific basis.

Starting with the demonstration of Pasteur in 1859, that the ammoniacal decomposition of the urine was due to the influence of organisms introduced into the bladder from without, a great number of researches have been made to determine the influence exercised on the bladder and kidneys by the action of micro-organisms.

It is recognized now that the decomposition of urea and the formation of carbonate of ammonia are brought about by micro-organisms of various kinds, and also that micro-organisms which have no power to effect this transformation of urea are the most potent agents in producing a local and general infection.

Klebs, Virchow and Lancereaux demonstrated the important rôle played by bacteria in the production of nephritis, ascending from the bladder along the ureters to the kidneys.

Omitting reference to many important communications bearing directly on this subject, we come to the modern observations and experiments which have led to the infectious theory of urinary fever.

Clado in 1887 made a bacteriological study of a bacillus which he obtained from pathological urine. He was able with cultures of this organism to produce in animals a general infection and death by injection of them into the peritoneal cavity, and a cystitis following their introduction into the bladder after ligature of the penis. The same author obtained a similar organism from puncture of the spleen in two cases of urinary fever with which he was not able to obtain any positive results on animals.

Berlioz succeeded in producing a nephritis by injecting this organism into the blood of rabbits.

Hallé found a similar bacillus in the urine, the kidneys, spleen, and blood of a patient who died as the result of attempts to pass a tight stricture. The same bacillus produced rapid death in guinea-pigs from general infection.

Albarran and Hallé, as the result of bacteriological studies of cases of urinary fever at the Necker Hospital, found this organism in forty-seven out of fifty cases of pathological urine in a state of purity or mixed with other germs.

In nineteen autopsies they found the same organism in the urine eighteen times; in peri-urethral abscesses, perinephritic abscesses, in infectious nephritides, in the blood, liver, and spleen it was found alone or associated with other micro-organisms.

These investigators succeeded in producing with this bacillus, which they named *bacterium pyogenes*, a cystitis, general infection, localized suppuration in the cellular tissue, and pyelonephritis with renal abscesses. They observed, during the course of a general infection, miliary cortical abscesses in the kidneys after the injection of the bacillus in the blood, and after the production of a pyelonephritis following its injection into the ureters afterward ligated.

The observations have in part been confirmed and supplemented by the investigations of others who have found other micro-organisms in the urine and kidney lesions produced by urinary fever, alone or associated with the *bacterium pyogenes*.

Aehard and Renaut found a bacillus in the kidneys of a woman who died of nephritis, which presented all the characteristics of the *bacillus coli communis* (Eseherich), and which they regarded as identical with this organism and with the *bacterium pyogenes*. This observation was confirmed by Reblaud, who recognized certain differences in the growth of the two germs on gelatin; he was inclined to think that a residence in the urinary organs had produced certain modifications in the germs.

Krogus, after a bacteriological examination of the urine from seventeen cases, arrived at the same conclusion as Achard and Renault regarding the identity of the *bacterium pyogenes* and the *bacterium coli commune*.

In addition to this bacillus, which seems to be a pretty constant inhabitant of the urinary organs, Rovsing has described three other microbes which are capable of infecting the kidney by way of the ureters or the blood.

While much progress has been made in the clinical, pathological, and experimental proof regarding the important part played by bacteria in the production of urinary infection, it is probable that many other micro-organisms not yet described will be found, which may assist or play an important rôle in its production, and that we will soon possess more definite knowledge regarding the respective influence of the germs and their soluble products.

The rapidity of development of the chill and fever, after an injury to the urethra or bladder in certain cases of acute urinary fever, would seem to speak decidedly in favor of the absorption of a toxine already formed in these organs. It is in such cases, however, which have developed with extreme rapidity and proved rapidly fatal that the presence of microbes has been demonstrated in the blood. The communication of the urethra with the air, its frequent seat of chronic inflammation, and the excellent culture medium afforded by the urine, especially in cases of incomplete retention, offer the most favorable condition for the propagation of germs either introduced spontaneously or by instruments. The changes which have taken place in the bladder wall in long-standing obstructive lesions with residual urine and the congestion of the blood-vessels, both in the bladder and kidneys, following the too rapid removal of the support to the vessel which such retained urine afforded, is soon followed by local and general infection unless care is used in antisepsis and in the gradual emptying of the bladder. It is in such cases also that an ascending bacterial pyelonephritis most frequently occurs.

It is difficult to explain why, under the same conditions, one patient will rapidly develop febrile manifestations following the slightest interference, while another will escape such reactions after prolonged and careless instrumentation. Under these circumstances it is necessary to consider certain variations in the virulency of the micro-organisms as well as in the resisting power of the patient. Albarran and Hallé have noted marked differences in the infective power of the *bacterium pyogenes*, where the cultures from different sources were placed under the same conditions. In a case of gangrene of the penis this bacillus was found in a state of purity, and gave rise to localized gangrene when injected into the cellular tissue.

Guyon, having observed that many patients with long-standing sup-

puration of the bladder were exempt from general febrile accidents following operative interference, has proposed the theory that they have acquired immunity by a kind of auto-vaccination from absorption of toxins or bacteria in a state of modified virulency.*

Diagnosis.—As a rule, it is a matter of no difficulty to establish a diagnosis of the various forms of urinary infection.

A patient who is the subject of an obstructive disease of the urinary apparatus, and at the same time exposed to malarial poisoning, may develop a train of symptoms which are often referred to the wrong cause. The fever and chills which depend upon a spontaneous urinary infection are irregular in their manifestation and are uninfluenced by quinine. The loss of appetite, vomiting, diarrhoea, and emaciation which occur in the chronic form of urinary fever may be and often are attributed to chronic gastro-intestinal infections rather than to their true cause. An examina-

tion of the bladder and of the urine should be sufficient to guard against an error in diagnosis.

Prognosis.—While the prognosis in the acute urinary fever with a single paroxysm is generally favorable, the outlook in the recurring variety is not so good, as the repetition of the attacks indicates, as a rule, the secondary involvement of the kidneys. In a certain percentage of cases, even when the kidneys are affected, a favorable termination may be looked for. In case the kidneys, the seat of one of the forms of nephritis due to obstructive disease, are in addition infected by the microbes in the blood (descending nephritis), the prognosis is extremely grave. (See Fig. 5.)

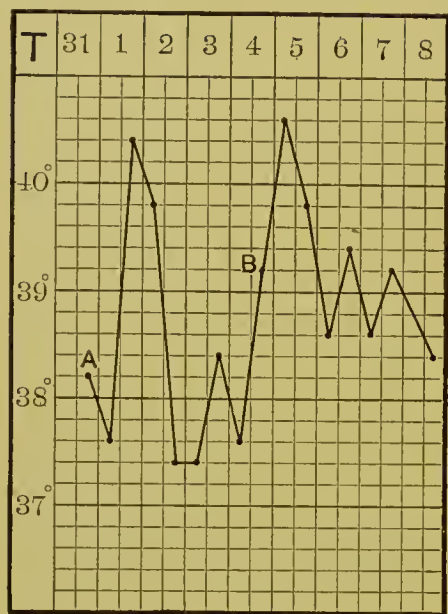


FIG. 5.—Combined renal infection by micrococci and the bacterium pyrogenes in a patient with stone in the bladder. Attempted lithotrity (A), followed by rapid elevation of temperature; suprapubic cystotomy (B). Death after four days. (After Albarran.)

A young man who develops a febrile paroxysm after dilatation of a stricture or internal urethrotomy has infinitely more chance of recovery than an old prostatic with long-standing residual urine. In the latter the prognosis depends on the duration of the obstruction, the changes which have taken place in the urinary organs, and the amount of residual urine.

* For a more extended account of the pathogenesis of urinary infection, the reader is referred to an article by Dr. Noël Hallé, in the February (1892) issue of the *Annales des Maladies des Organes Génito-Urinaires*, of which liberal use has been made in the foregoing article, and to a report by Prof. Guyon in the May number of the same journal.

The temperature is not always to be considered as of decisive prognostic value, as death may be preceded in subjects of long-standing obstructive trouble by a condition of apyrexia or by a subnormal temperature. Malignant forms of urinary fever begin with a prolonged and intense chill, sometimes repeated, followed by a high fever, convulsions, asphyxia, coma, and death, with suppression of urine. The intensity and rapid sequence of the symptoms speak in favor of a quickly fatal result.

Treatment.—A recognition of the infectious origin of the various forms of urinary fever, and of the conditions of the urinary organs underlying their development, has proved of signal prophylactic service.

A correct asepsis of all instruments introduced into the urethra or bladder, the use of Thiersch's solution or other antiseptic in irrigating the anterior and posterior urethra and the bladder, the internal use of boric acid (suggested by Dr. E. R. Palmer), salicylic acid, salol or benzoic acid for a period of twenty-four to forty-eight hours before operating, have, in the hands of many operators, reduced the frequency of these accidents to a minimum.

Bryson states (*loc. cit.*) that since adopting these measures he has had a comparative immunity from the urethral fever. In addition to the precautions mentioned, he carefully washes the glands and prepuce with Thiersch's solution before operating, uses borated glycerin only as a lubricant, and boils his instruments in a soda solution. The rules which govern the performance of operations on the urethra or bladder should be followed, care being taken not to use too large instruments in beginning the progressive dilatation of a urethral stricture or in relieving a distended bladder, so that an abrasion or tear of the mucous membrane may, when possible, be avoided. The urethra may be irrigated with Thiersch's solution after an internal urethrotomy when indications do not point to the performance of an external perineal urethrotomy or the use of a retention catheter.

In beginning the systematic use of the catheter in prostatitis, all the precautions should be taken which have been mentioned; in addition, one should avoid completely emptying the bladder, or replace a part of the evacuated urine with some mild antiseptic, in order to avoid the congestion of the bladder and kidneys which is apt to follow the withdrawal of the accustomed support to their blood-vessels. Should urinary fever develop in spite of the precautions used, the patient should be kept warm in bed with blankets and hot-water bags, and an effort made to encourage perspiration, which is the natural termination of a paroxysm, by the use of hot drinks and jaborandi. After the attack is over, a saline purgative may aid in eliminating the toxic agent. Little faith is now placed in quinine, aconite, or other remedies, which formerly were recommended as prophylactic or curative in this affection.

In the subject of renal insufficiency from obstructive disease, the use of milk with Vichy water, with careful attention to the condition of the alimentary canal and the functional activity of the skin, constitute accessory measures of great value.

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ON CYSTOSCOPY.

By WILLY MEYER, M. D.

History.—The problem of illuminating and inspecting the human bladder has been practically discussed by many medical men within the present century. A number of interesting instruments have been constructed by them for this purpose, and are to be found in the armamentarium of genito-urinary surgery. The invention of later years is always more or less based upon the principle and merits of the one of earlier date, and shows the author's desire to simplify the difficult task before him. The attempt has been made to explore visually various cavities or canals of the human body with the same new instrument. Thus, bladder and urethra were considered together, especially in the early beginning of this new endoscopic research.

We will in our brief perusal, as far as feasible, confine ourselves to the more important instruments which have been devised to facilitate the examination of the bladder—cystoscopy. But we must not fail also to make due mention of the work of the pioneers in this formerly dark field of surgical diagnosis, no matter of what little "practical" value it may be to-day.

In 1807, an article by Bozzini, a German physician of Frankfort-on-the-Main, was published at Weimar, with the title "The Light-Conductor, or Description of a Simple Contrivance for Illuminating the Internal Cavities of the Human Body."

The instrument devised by him is described and illustrated in this paper. It consists, briefly, of the chamber which contains the light and of the light-conductors, differently shaped

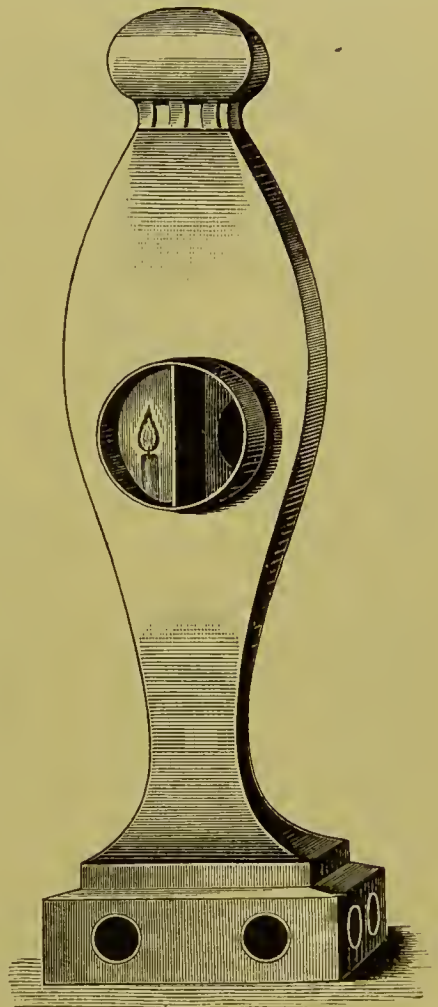


FIG. 1.

for the various organs. The former (the light-conductor, Fig. 1), of the shape of a vase, presents a round opening at its anterior wall, which is divided into two equal parts by a vertical septum running through to the posterior wall. From the one emerge the rays of the candle which distributes the light; through the other these return to the eye of the observer, which is to be posted at an opening in the posterior wall of the instrument. There is a projecting ring at the anterior opening on which fit the various light-conductors. These are introduced into the cavities of the body. The light was to be thrown through the conductor into the respective cavities and reflected from its walls into the observing eye.

Although these instruments did not and could not well find general recognition (they were even condemned by the Vienna faculty), they certainly mark the beginning of the many to-day so well-developed endoscopic methods.

Bozzini's instruments and articles had long since fallen into oblivion, when Ségalas (*Rev. méd. France et Etrang.*, Paris, 1827, i, 157) presented his "*speculum urethro-cysticum*" to the French Academy of Medicine in 1826.

Two years previous John Fisher had completed his instruments for inspecting the urethra. On the principle on which these were based, Désormaux, "the father of endoscopy," constructed his endoscope, which was laid by him before the Academy of Paris in 1853. He succeeded by his enthusiasm to also interest others in the endoscopic examination of bladder and urethra. His well-known work, *De l'endoscope et de ses applications au diagnostic et au traitement des affections de l'urèthre et de la vessie*, Paris, 1865, was the result of many years' hard work and studies. As this endoscope has been the model for a long series of later instruments, it deserves a short description.

As seen in Fig. 2, a lamp, which furnishes the light, occupies the greatest part of the apparatus. At a level with the light runs a transverse tube, which again carries another one attached to it in a right angle. This latter one can be turned around the transverse part in such a way that it runs in a horizontal line when the observer looks through it (Fig. 3). Its anterior (in Fig. 2 superior) opening carries the ocular lens, and a little below its middle the perforated reflector just opposite the lamp. With the help of an optic apparatus the light is concentrated before it reaches the mirror. It is then reflected from it toward the posterior (in Fig. 2 inferior) end of the tube, and further on, by means of the endoscopic tube which is fastened to the tube by a screw, into the urethra (Fenwick, *The Electric Illumination of the Bladder and Urethra*, second edition, London, 1889, pp. 3-10). The manifold modifications, or rather improvements, of this endoscopic apparatus may be divided into those which maintain the original as a whole and only change the light (Cruijs,

of Dublin, and Fürstenheim, of Berlin, substituting petroleum; Stein, magnesium), and into those which divide the complicated apparatus into its various components: the lamp or light and reflector and endoscopic

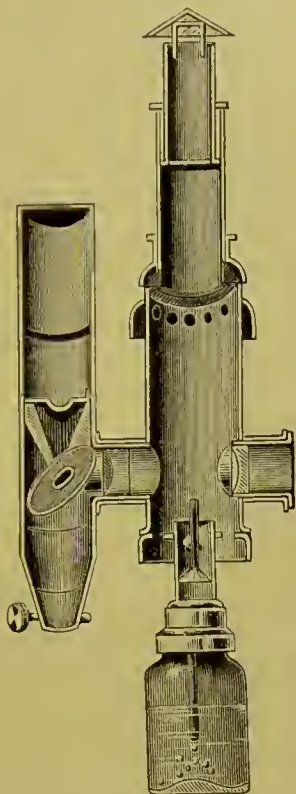


FIG. 2.

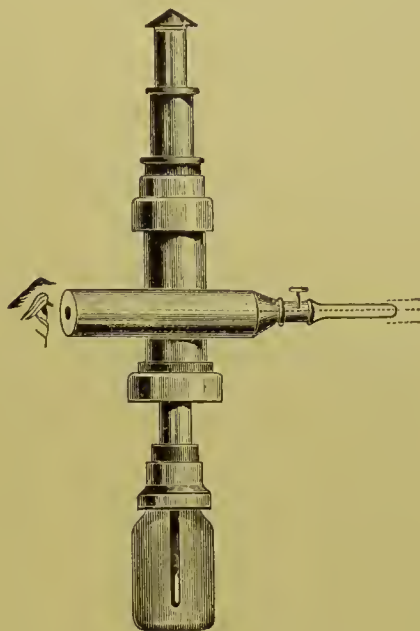


FIG. 3.

tube. This division is by far handier. Among the host of others who tried the latter in every imaginable variety, Gruenfeld, of Vienna, deserves to be especially mentioned. He has greatly improved the endoscopic tube.

Quite original and different from the former was the method of Bruck, a German dentist of Breslau, Silesia, who proposed to effect the illumination of various parts and cavities of the body by making use of the diaphanic qualities of the tissues (*Das Urethroskop und Stomatoskop durch galvanisches Licht*, Breslau, 1867). To examine the bladder, he advised to introduce a strong light—the white-hot platinum wire—into the rectum and a tube through the urethra into the bladder. Through the latter he then hoped to inspect the diffusely illuminated interior surface of the bladder. The heat produced by the hot wire was to be counteracted by a continuous circulation of cold water around the latter. It is not known whether Bruck or any other man ever carried out this plan.

Nine years later, in 1876, Dr. Max Nitze, of Dresden, now of Berlin, began his studies. He proposed and at last introduced two new principles into the method under consideration—the introduction of the light

itself into the cavity to be examined, and an optic apparatus which magnifies the spot coming into view.

It is the combination of these two devices which has mainly effected the immense progress of recent times. Nitze accepted the incandescent platinum wire for illumination which had been proposed by Bruck, but his first instruments remained quite defective. They were improved, however, and made available for use when Nitze moved to Vienna and interested the well-known instrument-maker of that city, the late Joseph Leiter, in the matter. By the combined work of these two ingenious men, of which the patience, perseverance, and technical skill of Leiter was by no means the least important factor, the "cysto-urethroscope of Nitze-Leiter" was at last completed, after many months of expensive and troublesome experiments. On the 9th of May, 1879, Nitze presented it to the Society of Physicians at Vienna (*Wiener med. Wochens.*, 1879, No. 24, and *Wiener med. Presse*, 1879, No. 26).

Later a controversy arose between Nitze and Leiter in regard to the invention of the instruments. There can, however, be no doubt that Dr. Max Nitze is the real inventor. The medical profession is greatly indebted to him for his continuous efforts, which now cover a period of sixteen years, to improve the instrument, and for his never-abating zeal to construct, in addition to the original cystoscope, others which might prove useful in diagnosis of urinary troubles and in the treatment of bladder-diseases. Leiter's work will also be forever appreciated; but we must never forget that the modern cystoscope is "*Nitze's cystoscope*." All the others are variations of his original ideas, whether manufactured at Vienna or at Paris.

Instruments.—As the fundamental construction of the original cystoscope of 1879 is the same as that of newest shape, it may be described here.* As seen in the accompanying sketch (Fig. 4), it consists of a silver tube of the shape of a catheter, in the short beak of which a platinum wire is fastened. The latter is made incandescent by means of an electric current, which passes through it and darts its rays upon the wall of the bladder through an open window in the concavity of the beak covered with a pane of rock-crystal. To convey the current of electricity to the platinum, an insulated wire runs through the whole length of the shank; the metal of the tube forms the connection with

* In the following, and throughout this treatise, I have freely used the material contained in my former articles on cystoscopy: *On Cystoscopy*, and the *New Cystoscope* of Nitze and Leiter, *New York Medical Journal*, April 20, 1888; *A Contribution to the Surgery of the Bladder*, *New York Medical Journal*, February 23, 1889; *Review of Nitze's Text-Book on Cystoscopy*, *Annals of Surgery*, June, 1890; and *The Progress of Cystoscopy in the last Three Years*, *New York Medical Journal*, January 30 and February 13, 1892.

the opposite pole. The platinum wire is surrounded by a combination of pipes, through which a current of cold water runs to keep the heated instrument perfectly cool. They measure only one millimetre and a half in diameter, and pass through the whole length of the sound, entering at its collar. An optic apparatus is introduced into the straight silver tube.

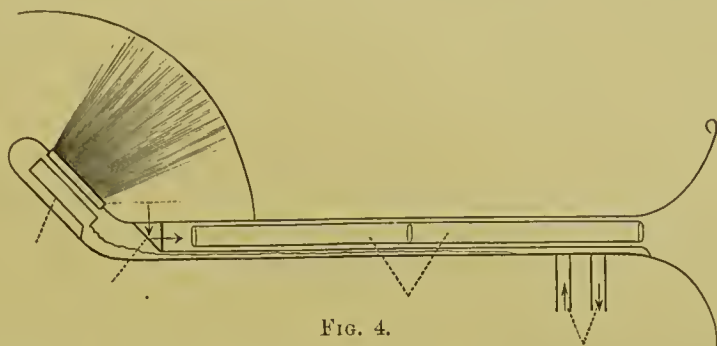


FIG. 4.

The combination of its lenses enlarges and magnifies the spot which comes into sight.* Without it we should not see much more at the time than a spot of about the size of a pea; with it we are enabled to inspect a portion as large as a silver dollar, and even more. At the junction of beak and shaft, corresponding to the concave side, a rectangular prism is cemented in, the hypotenuse-plane of which acts as a mirror on account of the total reflection of the rays. Thus is developed in the shaft a diminished inverted real picture of that wall of the bladder which is situated at a right angle to the longitudinal axis of the instrument and opposite the prism. It is again inverted by means of the lenses of the telescope and thrown to its outer end, where the examining person looks at the now upright picture through the magnifying ocular of the optic ap-

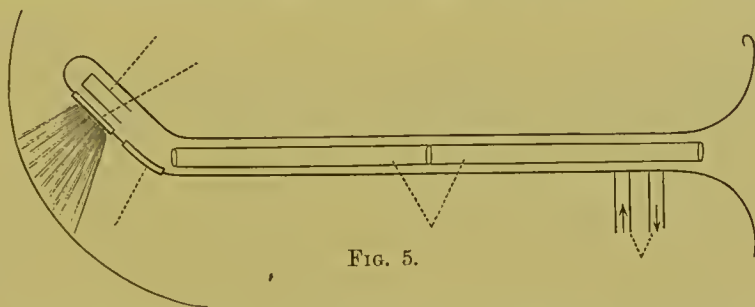


FIG. 5.

paratus. At the middle of the upper circumference of the funnel-shaped handle, called "funnel," a small knob is soldered. By this the operator can always tell to which side the beak points.

If the fundus of the bladder is to be inspected with this instrument, it must be turned 180°, and its handle in some cases slightly, in others

* It is by others called "telescope," to which term, however, Nitze emphatically objects. It is no telescope in the ordinary sense.

deeply, depressed between the thighs of the patient, who is put in the recumbent (lithotomy) position, the best for examination with the cystoscope. This manipulation is sometimes painful, especially in patients with a sensitive or enlarged prostate. To avoid this, a second instrument (Fig. 5) is made with the window for the incandescent platinum on the convex side of the beak. There is another window at the end of the straight tube, through which the observer looks with the optical apparatus. Of course, there is no prism.

In using the original cystoscope there were needed, besides a Bunsen-battery with a special fluid, a rheostat, to give the current with the necessary strength in each case, and a reservoir containing about two or three gallons of cold water; the latter continuously circulated around the heated platinum wire in order to keep the instrument cool. These accessory apparatuses complicated the instrument very much, and made it cumbersome and very expensive. In consequence of this, cystoscopy was formerly rarely employed. The new instrument was only bought by some larger clinical institutions and hospitals, and used by a few specialists and surgeons who interested themselves in the investigation of genito-urinary diseases, such as Nitze, von Dittel, Nicoladoni, Ultzmann, Sir Henry Thompson, and Maas. They all, however, repeatedly praised the method as a splendid means of diagnosing diseases of the bladder by direct inspection.

The enormous advance in electro-technique made in the last few years also improved the cystoscope. Edison's lamps of a very small caliber, the so-called mignon lamps, took the place of the platinum wire, and did away with the many unhandy accessory apparatuses, especially with the water-pipes. The new cystoscope is very handy, and not expensive. It is not larger than an ordinary short-beaked calculus sound (Mercier's), No. 22, French gauge.

In adopting the Edison lamp for illumination, Nitze and Leiter entered into a very bitter polemic, which later also extended over the claim to priority in regard to the invention of the original instrument. The consequence was, that Nitze had his modern cystoscope manufactured by Mr. Hartwig, of Berlin (Markgrafenstrasse 79), whereas Leiter produced another one at his factory, of course following Nitze's original ideas. Although it varies from Nitze's only in some trifles, it has entered the market and come into the hands of many medical men as "Leiter's cystoscope." This is a wrong term and an injustice to Nitze, as far as priority is concerned, which is now by all unhesitatingly conceded to Nitze. The latter therefore demands that the Leiter-instrument be called the Nitze-cystoscope, manufactured by Leiter. I agree with him.

The Modern Nitze-Cystoscope and its Varieties, manufactured by Hartwig, Berlin.—Nitze put the mignon lamp at the end of the beak unprotected. He found that the lamps are very strong and do not break by shock

or heat—a fact which has been, moreover, corroborated by a five years' experience of many cystoscopists. This arrangement permitted the use of larger lamps, and gives a free opening for the light.* It became possible also to make the beak shorter than before, as it is found in Mereier's catheter—a very important point. The lamp is fitted in a silver tip, which can be easily screwed on or off the end of the beak. Thus a lamp whose carbon-filament has given out or has been destroyed can be replaced in a moment (Fig. 6). The ocular end of the so-called funnel presents at its



FIG. 6.

base two isolated metal grooves (see Figs. 9, 10, and 11.) To these are attached the so-called tongs, a metal handle which is connected with the battery wires and carries a slot-key on its surface. This key slides under the pressure of the thumb, and makes or breaks the current. The lenses of the optic apparatus of the cystoscope give a very nice perspective picture, and cover a larger field than those of the other instruments to be mentioned later.

Nitze recommended three different cystoscopes for a thorough inspection of the entire inner surface of the bladder :

Cystoscope No. 1, which carries the lamp and prism at its concave side (the latter at the junction of beak and shaft). It represents the main instrument, "the" cystoscope, and is the one which is generally sold (Fig. 7). With it we are in most cases able to inspect the entire

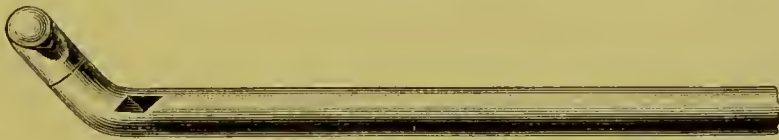


FIG. 7.

bladder. The shaft of this instrument is also made one inch longer. This will be found of advantage in many instances, especially in cases of hypertrophy of the prostate, when the urethra is materially lengthened.

Cystoscope No. 2, for the inspection of the fundus, constructed according to the principle of the second one of 1879. The beginner

* To heat the beak as little as possible the carbon filament of the lamps is longer and thinner than in the ordinary mignon lamps. On this account it offers more resistance to the current, and requires more electromotive force (9 to 10 volts) than that sold with the Vienna instrument (6 volts). To preserve his lamps, the cystoscopist should make it a rule always to determine the electromotive force required by each lamp previous to examination.

should not buy this; the experienced cystoscopist may need it in a few instances.*

Cystoscope No. 3, for illumination of the internal orifice of the urethra and its immediate neighborhood: lamp and prism on the concave side of the beak, which latter is about half an inch longer than in the others, and bent in nearly a right angle to the shaft. A small mirror, situated at the convexity of the curve inside the tube, reflects the picture which is thrown into the telescope from the reflecting plane of the prism. The picture seen with this instrument is indistinct. It is to be hoped that it will soon be improved. Although we are able to diagnose the hypertrophy of the prostate "in the picture" with No. 1, yet a thorough inspection of the internal urethral orifice and its surroundings under electric illumination would be very valuable in a number of cases.

The Irrigating Cystoscope.—This excellent instrument permits of changing the fluid in the bladder without itself being removed † (*Centralblatt für Chirurgie*, 1889, p. 949). It contains (Fig. 8) two small tubes in its shaft, which is thus increased in size to 25 gauge, French. (The size of the beak is 22, its length also the same, as in the others.) The one tube ends just in front of the prism, with three small holes side by side (*a*). It carries fresh water into the bladder. The other tube ends, or rather begins, with a single oval-shaped opening at one side of the lower end of the shaft (*b*); through it the water passes out of the bladder. Both tubes are carried to either side of the upper end of the instrument (*c, d*), and their current can there be shut off by a small stop-cock. Both these stop-cocks are attached below the funnel to a metal ring (*e*), which also carries the handle with the slot-key. To put the whole into working order, rubber tubes are attached and tied on the end of the two tubes of the instru-

* Nitze has lately constructed No. 2 according to the plan brought out in his No. 3 and thus removed the annoying sharp angle which is found in No. 2 of the old pattern (Fig. 8).



FIG. 8.

† Nitze had two irrigating cystoscopes made, a "simple" and a "more complicated" one. The former, oval in shape, only permits of throwing more water into the bladder; the latter, which is round, enables us to really change the water. Only the latter is to be recommended.

ment. It will be found of advantage to have the one which carries the water out of the bladder cut so long as to hang into a basin under the table. If the water is changed and the examination continued—which is frequently of great importance—an assistant or the patient must pump the water in. This latter manipulation is best done intermittently by sudden brief pressures on the handle of a syringe.

Advantages.—1. The instrument is round. 2. Its caliber is only three numbers larger than No. 1. 3. It is easily handled. 4. Irrigation can be effected without regard to the turning of the shaft. 5. The water, thrown in with the help of a hand-syringe, passes with considerable force over the surface of the prism, thus washing it and removing blood-coagula or pus shreds, which so frequently settle there and render a successful cystoscopy impossible. This is a very clever arrangement. 6. It often enables the observer to diagnose the solidity, and especially the insertion of a growth. The jet of water propelled across the prism and beak will make a pedunculated growth swing, while it leaves the sessile growth undisturbed. (The same result can sometimes be obtained in using cystoscope No. 1, by pressing with one hand in sudden short shocks on the epicystic region.) 7. In cases where papillomatous growths, inserted around the internal urethral orifice, cover the lamp and prism of the instrument as soon as it has entered the bladder, and darken the field of vision, thus rendering an examination impossible, the forcibly injected fluid pushes them aside. They will then be suddenly seen in bright illumination, swaying in the fluid. 8. Concrements and foreign bodies lying in the pouch behind a hypertrophied prostate gland, and not to be detected there by the examining eye, can sometimes be thrown by the water out of the recessus and thus diagnosed. 9. The instrument enables us to view the bladder in different degrees of distention. In a certain number of cases the ureteral openings can be seen only by this means. It also enables us, by letting off some of the fluid in the bladder during the examination, to finish the exploration of a very obstinate one in cases where No. 1 would decidedly fail.

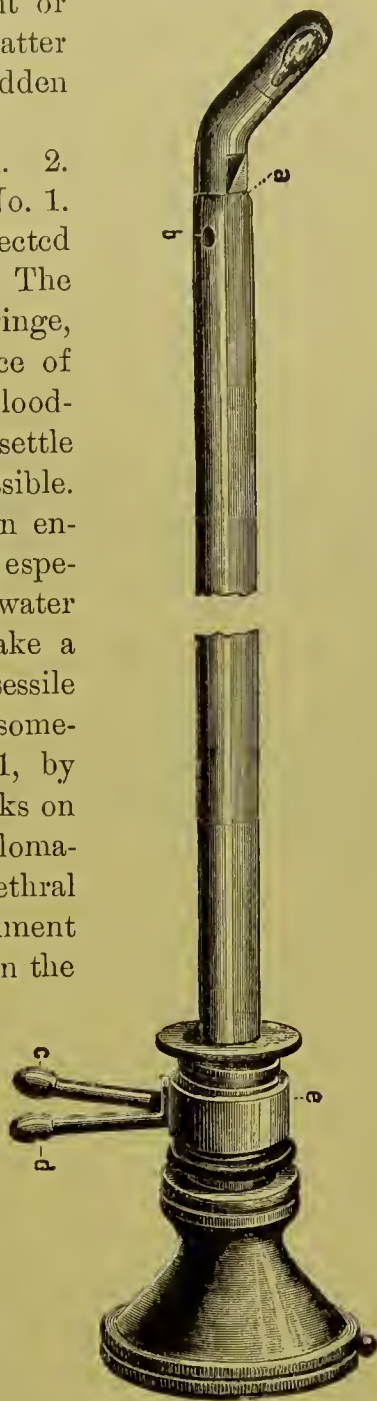


FIG. 9.

Drawback.—The three holes in front of the prism, through which the fresh injected water is intended to enter the bladder, are too small. It takes quite a while before one single ounce has passed them. I therefore inject only a very small quantity by this way first, just enough to wash off prism and lamp, and make the rest pass the larger tube, which generally gives exit to the fluid contained in the bladder. This is, of course, not quite as convenient. The arrangement for irrigation does not enable us, however, to flood the viscus or wash it out in the ordinary sense. Still, I have found it sufficient and of the greatest value in enabling me to detect an obscure bladder trouble, as well as in the diagnosis of renal disease, pyuria and hæmaturia. In examining the bladder of patients who suffer from such diseases, the originally transparent medium becomes rapidly and suddenly turbid, and the outlook is at once eluded by a dense fog; nothing can be distinguished. I succeeded, in one of these cases, where I had to perform nephrectomy for pyonephrosis and cystic degeneration, and therefore wanted to determine the condition and excretory power of the remaining kidney, in establishing the fact, just after fresh water had been thrown into the bladder, that the urine descending from the other kidney was clear. In other troublesome cases I could make out only with the help of the irrigating cystoscope that the large amount of pus which always turned the injected water murky in a few seconds was ejected from one ureteral orifice only. In abundant vesical hæmaturia, where the blood more easily coagulates, the irrigating cystoscope of the present size will be of little or no use at all, as the blood-clots generally block at once the canal which carries the water out of the bladder. Fresh water is then pushed into the vesical cavity, but the turbid fluid can not get out. If the hæmaturia be slight, the irrigating cystoscope is the only one which will enable the observer to finish the examination to his satisfaction.

The instrument just described is indispensable with proper cystoscopic work. I use it wherever I can, and would advise to only buy this one, were it not that on account of the slightly increased size of the shaft its use is only practical when the urethra is of a certain dimension (25 French).

Advantages of the Berlin Pattern in general.—Short beak, long shaft, nice perspective picture, variety of useful instruments.

Drawbacks.—1. A somewhat less brilliant light.* 2. The silver tip, the carbon filament of which has given out or has been destroyed, has to be sent to Berlin for putting in a new incandescent lamp. If in every large city an instrument-maker would take a number of new silver tips

* Still the light is white and entirely satisfactory in every case. Where we can not see with it for special reasons, we shall most probably also not succeed with one manufactured elsewhere.

in stock so that useless tips could there be exchanged for new ones, this disadvantage would at once be remedied.* 3. The screw of the different tips in stock will sometimes be found not to fit exactly on the thread at the lower end of the shaft; now and then it overruns the limit of screwing, or does not reach it at all. The surface of the lamp then points to another direction than the prism. The tip becomes simply useless. This is no real drawback to the instrument proper, but a mistake which can and has to be remedied by a greater accuracy of the instrument-maker. The latter must have a standard instrument on which the tips, before being sent away, should be carefully fitted.†

The Operating Cystoscope (Centralb. für Chir., No. 51, 1891, page 993). A cutting forceps is attached, by a peculiar mechanism, to the

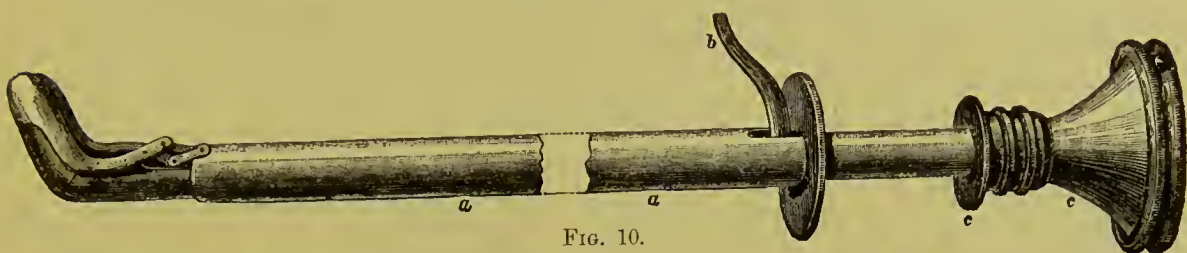


FIG. 10.

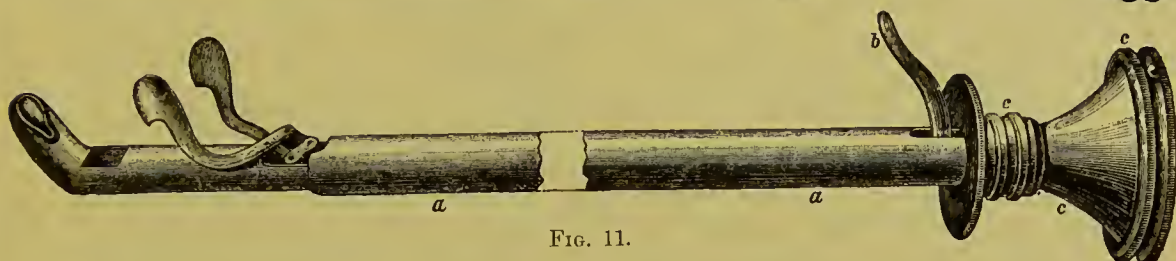


FIG. 11.

lower circumference of a cylindrical tube. Its two blades carry at their end a small, sharp scoop. They are opened and closed by a lever, which moves in a longitudinal slit at the upper end of the same tube. The whole is slipped on the shaft of the ordinary cystoscope No. 1, and can be moved on it, downward and upward (see Figs. 10 and 11). A few more instruments of a similar pattern have been designed for intravesical topical treatment.

To enable one to disinfect these different instruments, and also to

* I have tried to induce the Edison Manufacturing Company, of New York, to make these lamps. They have answered that they "can not at present undertake their manufacture." Mr. Hartwig has lately (August 10, 1892) informed me that the tips are now made of Nickelin, which is so much cheaper than silver that burned-out lamps can be thrown away *with the tips*. The expense is not greater, considering the necessary outlay involved by sending the silver-tips to Berlin and back, duty, etc. The main reproach to the Berlin pattern, made by cystoscopists not residing in Germany, would thus be eliminated.

† After some experience, with proper care and a good battery the same tip can be used for many months.

make the armamentarium which is needed for intravesical surgery as simple and comparatively cheap as possible, the funnel of the cystoscope has been made movable. It can be screwed on or off the shaft. Thus, we can use the same *cystoscope* for all the manipulations, and only need a number of the cylindrical tubes, which carry the proper mechanism. The cystoscope for this kind of work has, besides the movable funnel, a smaller caliber and a longer shaft than the ordinary No. 1. The instrument armed with the forceps has the size of an evacuator as used in litholapaxy; if armed with the other accessories, it corresponds to about Nos. 21 to 23 of the French gauge.

Before introducing the operating cystoscope, the cylindrical tube *a* is shifted down toward the prism, and the forceps (for instance) closed by pressing the lever *b* upward. The two blades then surround the beak in such a manner as to form one solid body with it (Fig. 10). The instrument will now easily pass a urethra which is not too narrow. As soon as it has entered the bladder the tube is slipped back toward the funnel of the cystoscope (Fig. 11), the light is turned on, the forceps, etc., opened, and everything is ready for the work. In looking through the telescope, the motion of the two blades of the forceps or of the cold or red-hot wire of the snare-écraseur can be thoroughly observed and controlled by our eyes.

This new instrument is not yet completed. It will doubtless greatly advance cystoscopy. The main improvement in the special cystoscope is, that the instrument, which hitherto could only be used for diagnostic purposes, can also be used for local intravesical treatment. With the same precision as in laryngoscopy, we can apply medicinal solutions to definite areas of the bladder mucosa without touching any other spot; we can cauterize (with the galvano-cautery) ulcers and flat tumors; * can tear off pedunculated growths with the forceps; can seize and extract foreign bodies, small stones, or the fragments of larger ones, which have been previously crushed. And all this under the direct guidance of our eyes.

Cystoscopes according to Nitze's Principles, manufactured by Leiter, of Vienna.—*The So-called "Leiter Cystoscope."*—In modifying the original cystoscope, Leiter adhered to the old pattern of 1879 (Fig. 12). He retained the hood with the oval window for the passage of the rays of light, closed by a piece of rock-crystal (Fig. 13). It can be screwed off the

* Of course, this can not be done if the bladder is filled with water. For such purposes it has to be expanded by air. As Nitze's lamp is situated in the extreme end of the beak, and heats comparatively little, it can burn in the open air for about two or three minutes without spoiling the prism. I presume Nitze intends to proceed in this manner. He promises, in his preliminary article, soon to give full particulars in a more elaborate essay.

shaft of the instrument in order to allow of access to the incandescent lamp, which has been substituted for the platinum wire. The terminals of this lamp fit into two sockets, which are in direct communication (by means of insulated surfaces) with the battery (Fig. 14). The carbon-filament of the mignon-lamp in the Vienna cystoscope is less delicate. Fol-

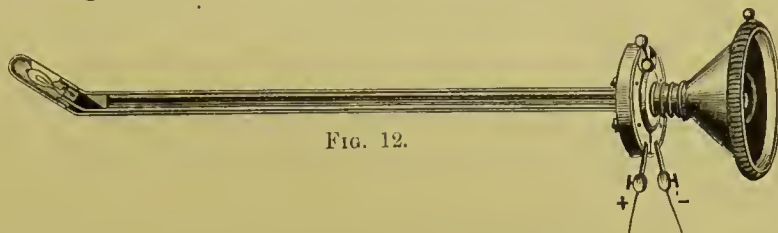


FIG. 12.

lowing suggestions of Hurry Fenwick, of London, many essential advantages of the Berlin instrument have later been secured, while many defects were eliminated. The length of the beak is now reduced to less than one inch. The elbow is rounded. The length of the shaft is increased to seven and a half inches. Fenwick also proposed to change the connec-

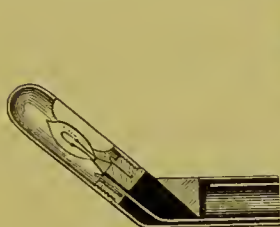


FIG. 13.



FIG. 14.

tion with the battery. The ocular end is now fitted with a rotary plate, carrying the binding screws for the battery wires; a small screw upon the face of this plate forms the switch (Fig. 15). In the instrument of 1887 the beak was nearly half an inch longer, the elbow presented an

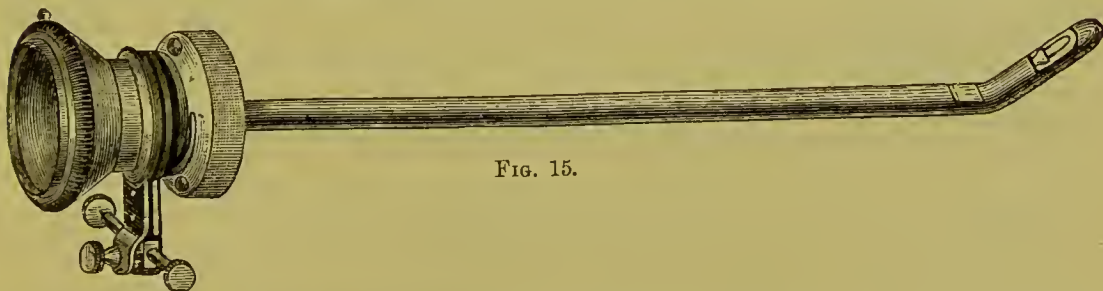


FIG. 15.

angle, the shaft was too short, and the battery wires had to be fastened in the binding screws, which were immovable upon the instrument, and thus would twist if the latter was turned around its longitudinal axis in the bladder (Fig. 12). The instrument is elegant and highly finished.

Advantages.—1. Carbon-filament of mignon-lamp less delicate; gives a bright light; requires less electromotive force. 2. If one lamp is de-

stroyed, only the lamp itself is changed; this is less expensive. 3. Every lamp fits (in the sockets).

Drawbacks in comparison with the Berlin instrument: 1. The lamp heats the beak more. 2. The beak is one quarter of an inch longer. 3. Length of that part of the shaft which alone must be considered with reference to the length of urethra (from inner brim of funnel to lower border of prism) is one inch shorter. 4. Optic apparatus slightly diminishes. Its lenses give a less perspective picture and cover a smaller field.* 5. Only one useful instrument is offered (corresponding to the Berlin pattern No. 1 short).

Fenwick's Modification.—Instrument as before. Silver cap perforated by three small holes on the side opposite the pane of rock-crystal, "to allow of a free current of water to surround the lamp, whereby the hood is kept perfectly cold" (Fig. 16).



FIG. 16.

Advantage.—Impossibility of burning the mucous membrane of the bladder, if examination of the anæsthetized patient is performed.

Drawbacks.—1. Can not be used in cases of hæmaturia (a non-perforated hood must therefore also be on hand. 2. More lamps are broken in its use. In buying a Vienna cystoscope it will be advisable to also order the perforated cap, which is, no doubt, a useful addition.

Variation introduced by Whitehead, of Manchester.—Instrument No. 1 of the Vienna pattern of 40 French gauge. Window of observation and incandescent lamp present double the size.

Advantages.—1. A wider field of vision. 2. Increased brilliancy of light.

Drawback.—Can be used only in the female; in the male it must be introduced through a median incision in the membranous portion of the urethra. Such an application directly annuls the special advantage of cystoscopy, namely, that "it affords a visual diagnosis without a cutting operation."

Brenner's Modification for Catheterizing the Ureters.—Cystoscope No. 2, of 28 French, which carries a separate small channel on the convex side of the shaft. This channel terminates just below the window, and can also be used for changing the water in the bladder (Fig. 17). It is occluded by a mandrel when the instrument is introduced. The mandrel later is extracted, and replaced by a minute English catheter or an

* Take Nitze's instrument in one hand, turn its prism to the window, and hold the palmar side of the slightly flexed fingers of the other hand at a distance of about two inches from it; then look through the telescope: you will see at once the fifth to second fingers and a part of the ulnar side of the thumb. Do the same with Leiter's cystoscope: you will see only two fingers and a half.

elastic metal sound. When the catheter or sound is in the ureter, the instrument itself may be slipped back over it.

Brenner thus succeeded in pushing the catheter into each ureter of a female patient exposed by the light, but failed to do the same in the male.

Advantage.—Allows of irrigating and sounding the bladder. The former must be done, however, through the same channel. In exceptionally favorable cases the observer may be enabled by it to catheterize the ureters.

Drawbacks.—1. It presents all those of the original Vienna pattern; at least, the instrument does which is in my possession. Shaft too short, six and a half inches; beak too long, one inch and a half; binding screws for the battery wires fixed upon the instrument; the old key for opening and shutting circuit. 2. Angle between shaft and beak too obtuse to permit of an easy instrumental access to the mouth of, and especially instrumental progress in the direction of, the ureters. 3. The field of vision covered by the system of lenses is small. 4. Continuous heavy leakage alongside the instrument which is introduced through the channel. It does not last very long and the bladder is found to be empty. The instrument in its present shape is useless, especially in the male.

Cystoscope according to Nitze's Principles, modified by Boisseau Du Rocher, and manufactured by Collin, of Paris (so-called *mégaloscope*).^{*} Vienna pattern No. 2, as used for an easy inspection of the fundus, elongated (Fig. 18). Compared with the latter its special striking features are: A longer beak; a longer telescope (Fig. 19), which causes the length of the instrument; an additional combination of pipes for irrigating the bladder, and also for passing the telescope, or passing instruments for catheterism of the ureters.

Probable advantages in comparison with the Berlin or Vienna instruments: 1. On account of the length of its telescope it is six to seven inches longer, and the face of the observer is therefore farther removed from the genitals than is possible in using the other cystoscopes. (But, on account



FIG. 17.

^{*} The medical profession should not accept this name, which was introduced by Rocher. We should only have modifications of a "cystoscope."

of the great length, a slight motion of the handle will result in a by far greater one of the beak, which thus will often touch the wall of

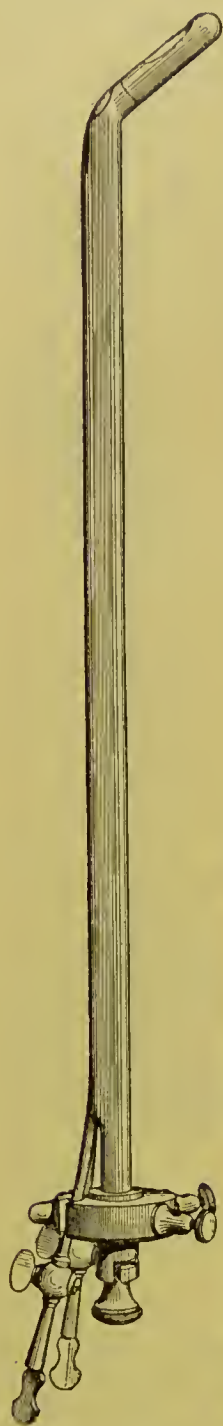


FIG. 18.

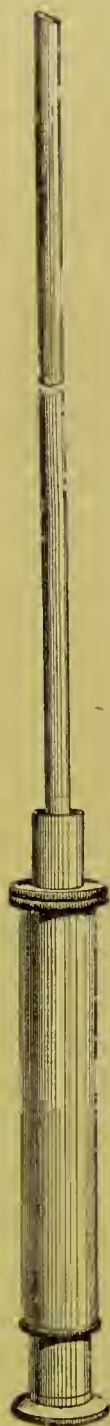


FIG. 19.

the bladder.) 2. We see everything in the same upright position as our eyes would see it without the telescope. (The latter advantage is also offered by the Nitze pattern No. 2.) 3. The pipes which run alongside and inside of the lower aspect of the shaft enable us to wash out the bladder before, and apply permanent irrigation during, the cystoscopic examination. There is a wider canal in the center of the instrument for passing the telescope. It is filled out by a steel mandrel while the instrument is introduced into the bladder. If we make use of this canal for irrigation, the viscus can be very thoroughly flushed. Of course, examination is during that time impossible 4. The larger one of the small pipes can be utilized for passing instruments of minute caliber for catheterism of the ureters. 5. The telescope is introduced, after the whole instrument has passed the urethral canal—i. e., is in the bladder. The objective lens can thus never be dimmed by an adherent mucus or pus-shred, or a small blood-coagulum.* 6. The instrument can be sterilized by boiling water, the cement, which is used for fastening the rock-crystal pane in the window of the beak, etc., being such as to stand a great heat. The other cystoscopes can not be boiled.

Drawbacks—1. We can not inspect the anterior surface of the bladder with this cystoscope, which, besides, is quite clumsy, and not at all as easy to handle as the others. Two instruments become necessary for viewing the entire bladder. Both can be bought at Collin's. 2. The caliber of the shaft is

* Compare Nitze's irrigating cystoscope. If we make it a rule always to inject some glycerin into the posterior portion of the urethra with the help of a Nélaton catheter after a careful irrigation of the anterior portion of the urethra, of the neck of the bladder, and of the latter organ itself, and before introducing the cystoscope, we cer-

No. 27 of the French scale, that of the beak No. 23. The increase of the size of the shaft is caused by the pipes for irrigation. It is to be mentioned, though, that they are situated at the lower aspect of the shaft, and thus give the tube a conical shape (cf. Brenner's modification). The top of this cone corresponds with the lower circumference of the urethra, which can be stretched. (The size of the other cystoscopes is No. 22; that of Nitze's irrigating cystoscope, the shape of which is round, No. 25.) 3. The beak is very long—half an inch longer than that of the Vienna and twice as long as that of the Berlin cystoscope. 4. The angle at the junction of beak and shaft is 130° , and abrupt; in the other two instruments only 145° , and well rounded. (The smaller angle seems to be of advantage, for the sake of catheterizing the ureters; see further down.) 5. The caliber of the two pipes used for irrigation and passing catheters for catheterizing the ureters is extremely small (No. 6, French). 6. There is no key or screw for opening and shutting the electric circuit. We always have to put in or unscrew one of the conducting wires for this purpose. 7. It is difficult to thoroughly cleanse the inner surface of the objective lens of the long telescope. This lens can not be detached from the tube, but has to be reached by a long conductor which holds at its end a piece of maple-marrow, etc.* 8. The spherical aberration of the lenses of the telescope. 9. A constant dripping of water out of the upper end of the instrument during examination. The intravesical pressure constantly forces the water alongside the telescope, which does not snugly occlude the lumen of the central canal. On account of the more perpendicular position of the instrument during examination this is not as marked and annoying as in the Brenner modification. The leakage is increased, if we use the smaller tube for catheterization of the ureters.†

The Paris instrument decidedly has a few important new features, which will make it desirable for the cystoscopist to be in possession of it. But, until the defects mentioned above shall have been remedied, we certainly shall always need the additional use of one of the other cystoscopes in the market, if we want to be ready to thoroughly perform a cystoscopic examination in cases where this method can be applied.

In closing this section, a tabulated comparison of the size of the different parts of the cystoscopes which are manufactured at Berlin, Vienna, and Paris, and attract special interest, may perhaps be welcome.

tainly shall rarely meet with this annoying occurrence when using the ordinary cystoscope.

* I have not, so far, succeeded in removing some particles of dust from the inner surface of this lens. A compliance with this need by the manufacturer would mean an improvement of the telescope.

† This latter leakage will be present in every cystoscope with a special channel for passing instruments for catheterizing the ureters.

warded me for these little inconveniences. Still, the more experienced may often find advantage in using the elegant instrument manufactured by Leiter in its new shape, as also that made by Collin, in spite of its manifold yet uncorrected drawbacks.

The Batteries.—In regard to the batteries, a great variety is now at our disposal. Hartwig, as well as Leiter, sells a battery with the cystoscope which fully answers the purpose (Nitze's Text-Book, p. 62; Leiter, Catalogue, 1889, pp. 13-17). The fluid is a mixture of pure chromic acid (trioxide of chromium, manufactured at wholesale by Sullivan & Co., Limited, British Alkali Works, Widnes, Lancashire; to be ordered of Messrs. Churchman & Co., Philadelphia), sulphuric acid, and water. (Formula for Hartwig's battery: Chromic acid, 375; sulphuric acid, 300; water, 3,000. For Leiter's: Chromic acid, 500; sulphuric acid, 375; water, 3,000.) Hartwig's battery, large size, is an eight-celled battery with Grenet elements. It is the one which I mostly use. The two original Leiter batteries, with hard-rubber cells, are not to be recommended, as they will surely crack and leak after a short while. The repair of such a crack is troublesome and always unreliable. Lately the cells have been made of glass, by which a very annoying disadvantage is at last eliminated. Fenwick uses a battery with a rheostat supplied by Sehall, of Wigmore Street, London. Sehall sells two batteries adapted for the purpose, one of very small size and light weight, which can be easily carried; and another large one, which only needs refilling every nine to twenty-four months. It is not intended for frequent transportation in private practice. Both are well spoken of. For cystoscopists on this side of the ocean who do not want to import the original Nitze battery, I would recommend the cheap and easily manageable, portable, small six-celled battery of the Galvano-Faradic Manufacturing Company, New York city. Not to destroy with it the incandescence lamp at once, the elements must be screwed very slowly and carefully into the fluid until the light is bright. In all these batteries there is no rheostat attached. I so far have never seemed to actually need the latter. In a more than four years' practice of cystoscopy the number of lamps destroyed by me is a very small one (except in the last four months). However, a rheostat is a useful addition to a battery. A very fine storage-battery, Gibson's (three different sizes), for office-work, is sold by the W. F. Ford Surgical Instrument Company, 315 Fifth Avenue, New York city. It contains four large cells, and has a rheostat. Its lighting power is ample. It can be arranged to permit of endoscopic and galvano-caustic work at the same time, which will be found especially convenient in urethroscopy. Recharging from a dynamo once in two to six months.* I have now used

* This is, of course, a disadvantage, as it makes the cystoscopist dependent upon the electrician. In houses that are connected with the street electric-light system, charging

this battery in my cystoscopic work for the last four months, and have destroyed more lamps with it than in the last four years combined. I have therefore returned to Nitze's fluid-celled battery, and use the Gibson's only for urethroscopy with Leiter's pan-electroscope.

Fixing the Picture as seen with the Cystoscope by Clay or Wax-modeling, Colored Drawings, and Photography.—Before entering the practical part of our subject, I have to call attention to the various attempts which have been made in this direction.

Fenwick, the originator of the first-mentioned method (Brit. Med. Jour., January. 5, 1889; and the Electric Illumination, etc., *loc. cit.*, p. 88), has proved, by the very pretty pictures in his work, how nicely and thoroughly the various pathological conditions of the interior of the living bladder, especially of tumors, if modeled in some plastic material—wax or clay—(and then photographed), may be recorded and demonstrated to others who could not attend the examination.

E. Burckhardt very lately gave us a fine collection of colored drawings of bladder images in health and disease (Atlas der Cystoskopie, mit 24 Tafeln in Farbendruck, Basel, 1891; see also the few excellent colored drawings at the end of Nitze's Handbook, and the three nice pictures in Albarran's work, Les tumeurs de la vessie, Paris, 1892, pp. 252–254); every one of them was observed by himself, and drawn at once with the cystoscope in position. The Atlas will especially be useful to the beginner, and explain to him many a picture which was seen but could not be at once identified.

Instantaneous photography, the *ne plus ultra* of cystoscopic delineation (Fenwick), is still in its infancy. Nitze has theoretically laid out an interesting method of best getting a small negative and then magnifying it. Want of time has not permitted him to make practical experiments (Text-Book, p. 325). Géza von Antal (Internat. Ctrbl. für Phys. u. Path. der Harn u. Sexualorgane, Bd. 1, Heft 1, p. 18), by his assistant, B. Hermann, published the photographic picture of the cystoscopic appearance of a black hair-pin in a female bladder. It is, however, entirely indistinct.

Fenwick (in connection with Mr. Pearson-Cooper, of the London Camera Club) has succeeded in obtaining good negatives of artificial growths both in the dummy and the dead bladder. But the negatives of the living bladder were too indistinct. A number of mechanical obstacles have hitherto offered an almost insuperable barrier to the practical success of such methods.

R. Kutner, a former assistant of Nitze, lately succeeded in overcom-

can be done at home. It also must be said that one set of lead-plates will generally not last longer than five years.

ing the principal obstacles to photography (*Dentsche med. Wochens.*, 1891, p. 1311). It seems that we shall now be enabled to "graphically record the many new and interesting clinical facts which the electric cystoscope is constantly revealing" (Fenwick). Two pictures in Kutner's article demonstrate what we may expect from cystophotography in the future.

Literature.—The literature on cystoscopy, which has appeared mostly within the last four years, is already very large. The fundamental and first work, upon which all the later various writings on the same subject, books, and articles, necessarily are based, is that of Max Nitze, which appeared in 1887: *Contribution to the Endoscopy of the Male Bladder* (*Archiv f. klin. Chir.*, vol. xxxvi, p. 661). Nitze left there hardly anything unsaid that could even be thought of in regard to the future progress in diagnosis and treatment of urinary diseases with the help of his instrument. In his *Text-Book on Cystoscopy* (Wiesbaden, J. F. Bergmann, 1889) he continued his original work. A similar thorough book is only found in the English language. It is the admirable and extremely interesting work of E. Hurry Fenwick (*Electric Illumination of the Bladder and Urethra*, London, 1889), who added many new and interesting facts from his large cystoscopic material to those first published by Nitze. A great many other articles bearing on cystoscopy, written by different men all over the globe, have besides been published, mainly within the last four years. All show original work. It is to be hoped that every cystoscopist will continue to publish his experience. If the facts laid down in these publications coincide with those observed by others under similar circumstances, certain fundamental pathognomonic "cystoscopic" symptoms of different diseases will have been established, and forever remain of value and importance.

The Employment of the Cystoscope.—There are three cardinal conditions:

1. The caliber of the urethra must be sufficiently large to allow of passing No. 22 French gauge.
2. The bladder must have a capacity of at least two, better four to five, fluidounces (60–150 c. cm.).
3. The fluid in the bladder must be transparent.

To comply with the first condition, the male urethra should, in suspicious cases, be first tested with the sound No. 22. (Nitze reports cases where the stricture was first diagnosed by passing the cystoscope, and following dilatation with the sound cured the entire trouble. Of course, cystoscopy was here simply not indicated.)

A narrow meatus is to be cut inferiorly, under cocaine. This procedure will be very rarely necessary.

With reference to the second point, it is important to remember that

the beginner should always endeavor to have five ounces of fluid thrown into the bladder. We know, from Nitze's investigations, that this amount just expands *all* the folds and grooves of the intravesical surface.* Only in this way, by training one's eyes to inspect the surface of the properly and more or less always equally expanded viscus, can one hope to learn gradually how to avoid mistakes in cystoscopic diagnosis.

(I know of two cases of chronic ulcerative catarrh of the bladder where, owing to an insufficiently distended bladder (two or three ounces only were borne), the observer was misled to diagnose a tumor. In both cases a portion of the bladder wall, not yet expanded, had been mistaken as such. In one of the cases, that of a young man of thirty-one years, the bladder surface showed an irregular cicatrization, especially around the spot in question. The scar-tissue seemed to prevent a more regular distention. In the other case, that of a young lady of seventeen years, there were numerous florid ulcerations.)

The more experienced practitioner, however, will not find cystoscopy contra-indicated, even if the bladder be irritable and expel the larger amount of fluid. With the irrigating cystoscope in hand success is still possible. The minimum amount of fluid, however, is two ounces. A bladder which holds less can not be illuminated (for reasons, see under "Possible dangers," etc.). On the other hand, the cystoscopist should be cautioned against injecting much more than five ounces. The anterior wall of the bladder will then be so far away that it can not be properly inspected.

But the filling of a diseased bladder to the proper extent is sometimes rendered impossible on account of its irritability. What means are then at our disposal to facilitate the examination?

Cocaine.—Nitze is in the habit of using local cocaine anæsthesia in nearly every case, in order to render the manipulations nearly painless. He injects in all fifty cubic centimetres (one and two-thirds ounces) of a two-per-cent solution (=fifteen grains of the drug), and takes pains that this fluid reaches every part of the urethra and bladder.

For this purpose a few cubic centimetres of the solution are first injected into the anterior urethra with an ordinary urethral-syringe. Then the bladder is emptied with a soft-rubber catheter, and washed, if the condition of the urine render it necessary. About half of the anæsthetizing fluid is then thrown directly into the bladder with a hand-syringe, and the rest made to pass the posterior urethra by slowly withdrawing the catheter until the fluid again appears at the external meatus. In short, we perform an irrigation of anterior and posterior urethra with a cocaine solution, as we do in a case of chronic specific urethritis with one of the ordi-

* This is especially important for examining the mouth of the ureters.

nary antiseptic lotions. At last the catheter is pushed back into the bladder, and closed by a stop-cock. After five minutes the cocaine solution is replaced by one-half-per-cent solution of carbolic acid (sterilized physiological salt solution answers the same purpose; boric acid lotion, which is slightly muddy, not as well). A sufficient degree of anæsthesia will now have been effected.

Fenwick injects a drachm or more of a twenty-per-cent solution of cocaine (about the same amount of the drug as Nitze does) into the water which had been poured into the bladder. "It there rapidly diffuses itself throughout the water, and serves not only to deaden the sensibility of the vesical mucous membrane in spasmodic cases, but also to allow of a still larger introduction of the boracic solution, if a difficulty in tolerating the necessary quantity is experienced by the patient." Besides, he also "sometimes squirts a little of a twenty-per-cent solution of cocaine into the urethral canal, anæsthetizing especially the prostatic section." He adds that "no apprehension need be felt about this application," as he had never seen any case presenting symptoms of so-called cocaine-poisoning.

Up to six months ago, in a few years' large cystoscopic practice, I also had never seen anything which might have induced me to look at cocaineization of irritable bladders as a possibly dangerous affair. I had always made it a rule to use cocaine, *if indicated* (otherwise not), according to Nitze's plan—that is, I always made the solution run off before properly expanding the bladder for examination. For special reasons, I left in one (the first) case the fifty cubic centimetres of the two-per-cent solution in place, adding three more ounces of sterilized 0.6-per-cent salt solution, and barely escaped having a death from cocaine poisoning in my office.

Mr. W. P., sixty-eight years old, came to my office through the courtesy of Dr. W. B. Graves, of East Orange, New Jersey. He suffered from intermittent retention of urine with occasional slight hæmaturia, prostate enlarged. February 23, 1892: Cystoscopy, with local cocaine-anæsthesia, as mentioned above. Fifteen minutes later the following sudden serious attack set in: Convulsive twisting of right lower extremity, less of left, and of both arms (flexors exclusively involved); also twisting of muscles of face, strabismus, turning of head to the right, perspiration of head and scalp, hallucinations—saw birds and bugs). Pulse 156, comparatively full and regular; respiration rapid. Symptoms lasted unabated for forty-five minutes, then began to pass off. One hour later, still twitching of muscles around mouth and orbits. Pulse 158, respiration 32. Aphasia. Continuous inhalations of nitrate of amyl proved of the greatest benefit. Besides, digitaline $\frac{1}{100}$ of a grain was given subcutaneously. About one hour later patient was still weak, but able to leave the office.

Albarran (*loc. cit.*, page 235) reports a death under these circumstances:

In a case of irritable stone-bladder only two ounces of a one-per-cent solution of cocaine (equal to nine grains of the drug) had been thrown into the bladder,

and the greater part of it a few minutes later withdrawn as soon as the first symptoms of poisoning had been noticed, and the bladder thoroughly washed. Two minutes later convulsions set in, the patient became cyanotic, and died barely fifteen minutes later, in spite of the most vigorous attempts at saving his life.

These two cases show beyond a doubt that even a small dose of cocaine, if injected into the diseased prostatic portion of the urethra and the vesical viscus, may prove dangerous or even fatal, and can be reabsorbed by its mucous membrane with the same rapidity as if it had been given by hypodermatic injection. It will therefore be our duty to be careful, in that procedure, certainly not to leave the solution in the bladder longer than five minutes. But even then we can not always rest assured to be on the safe side.

Morphine.—The application of morphine by subcutaneous injection or suppository generally quiets an irritable bladder markedly. For obvious reasons, it is only in place if the examination is made at the patient's house, where I have often made use of it with advantage—more so, if it was combined with a careful application of cocaine.

Narcosis.—The cases are comparatively rare in which we have to resort to its help. In a large number of patients who were submitted to cystoscopy by Nitze during a period of nearly three years, only three had to be narcotized (Text-Book, page 118). Still, in view of the possible dangers of cocaineization, I must confess that I shall henceforth oftener use general anaesthesia in patients with a very irritable bladder, where local anaesthesia might at last also succeed, except in office practice. I can not see that this possible necessity for narcosis offers any objection to cystoscopy, especially not in the so-called obscure urinary troubles of old standing with a very obstinate bladder, which compose a large part of the cystoscopist's material. Does not the gynæcologist make it a *rule* to examine his patients under an anaesthetic, in order to clear up by thorough "painless" bimanual palpation the pelvic trouble, to get at the correct diagnosis in its different parts as closely as possible? Is the result of the cystoscopy examination less important? A suprapubic cystotomy, nephrotomy, or nephrectomy, generally confines a patient longer to the bed than the extirpation of a pyosalpinx or a cystic ovary.

Certainly the different forms of anaesthesia should only be employed according to precise indication. The majority of cystoscopy examinations can and should therefore be performed without it.*

* Nitze divides the cases with irritable bladder into three classes:

1. If the bladder be greatly contracted, and its walls so infiltrated that the slightest artificial distention is not borne, even chloroform will be of no avail. Cystoscopy can not be performed.

2. Capacity also small; frequent desire to urinate. Causes: Superficial catarrh, reflex irritation, real smallness of bladder.

Fenwick employs anæsthesia: *a*, in young females for reasons of delicacy; *b*, in tuberculosis or similar cases where the prostatic urethra is extremely sensitive; *c*, when it is necessary to demonstrate some particular disease to a number of visitors; *d*, in order to make a leisurely prognosis of a discovered growth, so as to determine the expediency of operating for its removal (*loc. cit.*, page 73). Albarran proposes to try the rapid bromethyl narcosis (*loc. cit.*, page 236).

As it has been seen, grave obstacles to cystoscopic examination will be sometimes encountered. Frequently these will be overcome by experience, patience, and careful handling; now and then they will prevent the examination. In nearly every case these obstacles depend on the catarrh of the bladder. In cases of tumor this accompanying catarrh has "always" been carried into the bladder by the doctor, with the sound or catheter. Nitze therefore absolutely forbids the introduction of such an instrument into the bladder of patients where a vesical growth is suspected. The cystoscope must in future be *the first instrument* which is resorted to in these cases. The general practitioner therefore must realize the eminent pathognomonic importance of a spontaneous symptomless hæmaturia.

The third condition, that the fluid in the bladder be transparent, and that the beak may enter the bladder without dimming the prism and lamp, was formerly in many cases not possible of fulfillment. If, for instance, we examined a case of suppurative pyelitis or of hæmaturia with cystoscope No. 1, the originally transparent medium rapidly, often suddenly, turned turbid, and the light seemed to be placed in a yellow or red fog. Everything was obscure. It was necessary to withdraw the cystoscope, and reintroduce it after replacing the murky medium with clear water. One glance in bright illumination, and again a dense fog suddenly came up and threw a heavy veil over the whole landscape. This would be a case where cystoscopy "failed"! Or, we had an older patient with an enlarged, easily bleeding prostate gland and vesical catarrh. Sometimes the hæmaturia was quite abundant. Was the latter perhaps caused by an accessory trouble—tumor, stone, etc.? Urethra and bladder were very

a. Mild cases: With cocaine little improvement. Morphine; wash with small quantities; at last inject the five ounces intermittently; compress penis until cystoscope is introduced.

b. Severe cases: Preparatory treatment advisable—rest, suppositories, oleum santali; instillation of nitrate of silver. Must individualize. Systemic stretching of bladder with "hand-syringe." For examination proper: Combine cocaine with morphine; if necessary, chloroform.

3. Capacity ample; painless irritability after washing had been started.

Give first morphine; do not force injection of the five ounces at once. If, during injection, contraction sets in, wait until it has passed. Use hand-syringe (this is necessary in every case). Eye of catheter must be in the cavity, not at the neck. Compress penis until cystoscope is in urethra.

carefully washed, glycerin injected into the posterior urethra, the cystoscope put in. The entire field of vision appeared red; everything was indistinct. Sometimes the mucus or pus shred or the small blood-coagulum, which had settled on the prism or lamp on their way into the bladder, could be successfully removed by mechanically wiping these parts of the instrument on the fold of mucous membrane which surrounds the internal urethral orifice (Nitze, Text-Book, page 110). If they stuck in place, however, the disgusted cystoscopist had to stop the examination. The instrument, when extracted, showed the cause of the failure as just stated. The patient refused a second trial. Conclusion: "The instrument fails under certain conditions, unhappily usually there where its use seems to be mostly needed." Nitze's irrigating cystoscope has obviated such a disappointment. Its prism and lamp are thoroughly washed, and a murky medium is easily changed. (Of course, for lubricating the cystoscope, glycerin must be used; vaseline would dim lamp and prism.) We therefore have to change the chapter on "Limitations of the Cystoscope," established by those authors who so far only worked with the Vienna instrument. The only condition in regard to the medium which is really liable to limit the use of the cystoscope, even in the hands of the experienced, is an obstinate and abundant vesical hæmaturia. In such cases the cystoscope is best introduced after the bleeding has ceased, and when a sufficient amount of urine is probably in the bladder. Washing will frequently start the hæmorrhage again. If, for any reason, waiting is impossible, Nitze's advice should be borne in mind, not to empty the bladder completely while washing it. The definite contraction of the empty organ will always produce new hæmorrhage. Blood-clots will be best removed through the lithotrite catheter. To get a satisfactory picture, the examination is then made under constant irrigation (Albarran). If the instrument has to pass a prostate which bleeds at the slightest touch of a solid instrument, irrigation should be started when the beak passes the posterior urethra and neck of the bladder.

Possible Dangers in using the Cystoscope.—*Burning the Mucous Membrane.*—"Although the heat emitted by the cap or hood with its contained incandescent lamp," says Fenwick (*loc. cit.*, page 50), "when in action, is not so great as that given off by the platinum-wire lamp, yet it does become very quickly hot if it is allowed to burn in air instead of under water. Thus, it becomes warm after four seconds, unbearable after ten, and scorches the skin severely after fifteen seconds. If, however, the tip of the instrument is placed in water, the heat is rapidly absorbed and the cap or hood remains cool, and may be touched with impunity even after an hour's use. This is exactly what happens in the bladder, for the urine carries off the heat of the lamp as fast as it is formed." Its temperature is not perceptibly raised, even if the lamp is burned for an hour in the

bladder; but as soon as it comes in contact with the sensitive mucous membrane of the bladder wall, the patient invariably has a burning sensation. It will be readily understood that a longer unintentional contact, for instance, during narcosis, may really burn the mucous membrane. This will easier occur with the Vienna instrument. Its carbon-filament is shorter and thicker than in the Berlin, and the lamp, situated in the middle of the beak and covered by the rock-crystal pane, heats the entire cap. On this account Fenwick devised his perforated cap, as above described. The short-beaked Nitze cystoscope, manufactured at Berlin, carries the incandescent lamp in the tip *uncovered* in direct contact with the surrounding medium. If its beak touch the bladder wall it also creates a slight burning sensation. For this reason it becomes necessary to constantly have surrounded the beak by a sufficient quantity of water, in which it may freely move without touching the vesical wall. This is the reason that cystoscopy is impossible if the bladder retain less than two ounces (cf. above, page 164). If the cystoscope is carefully handled, the danger of burning the mucous membrane is certainly not great. In a large number of cystoscopies, with or without anæsthesia, I have so far never had a mishap.

Breakage of the Lamp.—(Fenwick, *loc. cit.*, page 51). This is a groundless fear, and decidedly no objection whatsoever to the Berlin pattern. The latter is at present used in every country of the globe. But a case of breakage of the lamp “splintering the glass” has never been reported. It certainly would, had it ever been observed.* Such an occurrence necessarily would condemn the entire arrangement. Nitze carefully compared the resistance to mechanical injuries of the mignon-lamp, as used in his Berlin pattern, with that of the rock-crystal pane. The result was in favor of the lamp. The fear is therefore “happily quite groundless,” not only for the Vienna lamp, but also for that of Berlin.

Infection of the Bladder.—This accident is easily possible if the cystoscope is carelessly handled. As mentioned above, the Berlin and Vienna patterns can not be sterilized by heat.† Prism and lamp make

* In my four years' practice it has happened to me twice that Nitze's lamp, which had given a bright light just before examination was started, burned darker and darker when turned on inside of the bladder. The circuit was broken and the instrument pulled out. It was seen that the lamp itself had filled with water. (Probably the lamp had been injured on its trip across the ocean.) The glass had cracked in all directions, but not one single splinter was loose, or could be artificially loosened in spite of manifold attempts.

† Nélaton's soft-rubber catheter can not be boiled either. Still, it is daily in the surgeon's hands, and, if properly attended to, is considered a safe instrument as far as asepsis is concerned. In adopting the cement as used by Collin, of Paris, the cystoscopes manufactured in Berlin and Vienna might in future perhaps also be rendered aseptic by boiling them.

the surface of the instrument irregular: there are grooves and depressions at their borders. Nitze's irrigating cystoscope has a system of minutest pipes. Septic material can easily settle there. Being aware of this, the conscientious cystoscopist who is used to aseptic work will take double pains to have his instrument thoroughly disinfected *as soon as the examination has been finished*.

Rules for disinfecting the Cystoscope after each Examination.—*a.* No. 1 (or 2). Rub the instrument thoroughly with a piece of aseptic gauze or a small soft brush soaked in a five-per-cent solution of carbolic acid; pay special attention to the various grooves. (If an infected bladder had been explored, the lower half of the instrument should be besides immersed in a five-per-cent carbolic solution for about one hour.) Dry well with another piece of gauze, and polish with a piece of chamois; then put it away.

b. Irrigating Cystoscope.—Throw a good deal of five-per-cent carbolic solution forcibly with the hand-syringe through the pipes; then put the instrument, nearly up to the funnel, in the same solution for about one hour. (A long, narrow glass jar, used for measuring fluids, answers this purpose very nicely.) Afterward irrigate with sterilized water; dry as before.

By carefully following these precautions I so far have never had the mishap of infecting a bladder or aggravating an already existing catarrh by the cystoscopic examination.

Hints on the Preservation of the Lamps, and on keeping the Berlin Instruments in Good Working Order.—Always determine the proper strength of current which is necessary for amply lighting the lamp, *before* the instrument is introduced into the bladder. Do this by holding the beak under water in a bowl.

Screw the elements slowly down into the fluid until the contour of the carbon-filament is unrecognizable, and the *entire surface* in the cut-out of the tip emits a bright, white light. The resistance offered by the carbon-filament to the current is different in each lamp. Use for the purpose as few elements as possible; in Nitze's battery generally from four to seven will be required. No new element should be added until those already in circuit have been entirely immersed in the fluid.

If the fluid has been recently renewed, the strength of the current is greatly increased for a short time. One to two elements less should then be used first. Do not shake the battery.

If the cystoscope is new, smear some varnish mixed with red lead (vermilion) around the borders of the prism. This mixture should have the consistency of honey. It should be done a few times only within the first months.

Keep clean and dry the two circular grooves at the upper end of the

instrument, as well as the concave surface of the rotatory handle, which, when attached to these grooves, conveys the current from the battery to the instrument. This refers especially to the irrigating cystoscope.

Turn now and then the screw home which holds the slot-key in place. If it works too easily under management of the thumb, the light will be less brilliant. Sometimes the cystoscope turns too easily in the handle. Then leave the left hand at the upper end of the cystoscope during examination, while pressing the handle with the other hand tightly against it.

If the lamp of a new tip does not burn at once when the current passes its filament, straighten the little cork-screw-like silver wire at the base of the tip before the latter is screwed on. This will often be sufficient to secure a bright light.

Small bubbles of air will often arise with a peculiar noise from the junction of the shaft and tip. They are produced by the decomposition of the water caused by the electric current. Smear a bit of wax upon the lower groove of the screw at the tip, with a hot wire dipped in the wax, previous to its being adjusted. This is best done whenever a new tip has been put on.

Do not clean the instrument with silver-powder. It might scratch the prism. Do not extract the optic apparatus.

If the instrument has to be repaired for one or the other reason, send it back to the maker.

Rules for performing Cystoscopy.—The cystoscopist should accustom himself, especially in cases which he sees in consultation, first to obtain a thorough history; then to make a general examination of the patient, especially with reference to tuberculosis; to carefully analyze the urine; to palpate the lumbar region of each side, the testicles and the prostate, the bladder bimanually if necessary, and test the caliber and length* of

* It is of importance to measure the length of the urethra, especially in cases of hypertrophy of the prostate, to be sure that the prism will not only enter the bladder, but can be pushed back to its posterior wall. This manipulation is a *sine qua non* for a thorough examination (see Important Points in examining the Bladder). It is true we can gain a few centimetres by compressing the pendulous portion of the patient's urethra; but if the prostatic portion be materially lengthened, this compression is not only painful for the patient, but is a mechanical impossibility. We therefore have to measure the length of the urethra, and in accordance with it select the proper instrument. If the length is eight and one third inches (twenty-one centimetres), we can use cystoscope No. 1; if longer, we will take the longer No. 1. Nitze very cleverly made his irrigating cystoscope according to this last size. The latter will therefore, also in this reference, always be the preferable instrument in such cases, if the urethra is of 25 French. An easy way to measure the length of the urethra is the following: Measure length of Nélaton catheter from outer end to eye; introduce same until urine just begins to run off; measure length of portion of catheter in front of external meatus; subtract from original length (Nitze).

the urethra. The operator should always start with the case as if he did not yet possess the cystoscope to enable him to view the interior of the bladder. He should push his means of diagnosis as far as possible by rational signs and examination of the urine. But the first instrument he then takes in hand, provided its use is indicated, should be, not the sound, but the cystoscope. Only when a stone in the bladder is strongly suspected should the sound be used first.

Before introducing the cystoscope, we put its beak into a glass bowl under water, push the slot-key on the handle forward and turn the winch of the battery, slowly immersing the elements into the fluid. The full strength of the current allowable for getting a bright light is determined and the circuit broken (see above, Hints, etc.). Previous to this the patient's bladder had been prepared according to indication (see above, Conditions indispensable for the Employment, etc.). The patient is in the recumbent (lithotomy) position at the edge of a *high* upholstered table or examining-chair, with flexed thighs and knees, the feet resting upon adjustable holders. I always have my male patients take off trousers and drawers, but keep on shoes and stockings. (Fenwick has his patients sometimes lie on the back, "with the trousers unbuttoned and thrown a little way down. A clean towel is placed across the trousers, upon which the right side of the observer's face can rest while he is looking down the cystoscope.") Once more we close the circuit for a moment, to be sure that the connection with the battery is in order and the light sufficiently bright. Now the meatus is wiped off with a ball of cotton moistened in a two or three per cent solution of boracic acid, the beak lubricated with glycerin and introduced.* This manœuvre is just as easily performed as the passing of a sound. As in that case, it must be gently done, without any undue violence. The position of the instrument, the length of the portion already introduced, and a certain slight jump in passing the neck of the bladder, will tell the experienced when the beak of the cystoscope is *in situ*. Involuntarily he will push the key forward and look into the bladder, which now presents itself in brightest illumination. The novice had better first turn the beak laterally, to be sure that it moves freely in the fluid, before he lights the lamp.†

* The funnel is for this purpose firmly grasped between the thumb and second finger of the right hand, while the same fingers of the left hold the anterior portion of the glans in such a way that the meatus is gaping. Attention is paid to the point that the small knob which is soldered to the outer brim always points directly upward. If the irrigating cystoscope is used, the passing of the instrument through the urethra may be facilitated if vaseline is smeared on the shaft as soon as the beak and a little of the shaft have entered. With cystoscope No. 1 this is not advisable, as changing of the fluid and re-introduction of the instrument may be required.

† Of course, the circuit is broken before the cystoscope is extracted from the bladder when the examination is finished.

Important points in examining the Bladder with the Cystoscope.—It is the observer's task to inspect the entire inner vesical surface as quickly as possible and with the least annoyance to the patient; also to bring into sight every spot of the interior of the bladder with mathematical exactness. This can only be done if the instrument is scientifically handled after it has entered the bladder. According to Nitze (page 91 and following pages), the beak in the bladder must be put for this purpose into five different positions, and then moved in each of them in a determined direction.*

Fig. 20 (Nitze, page 95) presents a schematic frontal cut through the middle of the body of the bladder; x is the frontal cut through the shaft of the cystoscope.

(A) Beak points *upward*.

1. As soon as the beak has passed the internal sphincter muscle it is turned to the right side of the patient for an angle of $22\frac{1}{2}^{\circ}$ from the vertical line (Fig. 20, *a*) and pushed forward until it touches the posterior wall, the funnel of the instrument being slightly raised during this time. To bring most of the posterior wall in view, the funnel is still more raised as soon as it is close at it. The segment observed in this manipulation is marked A in the figure.

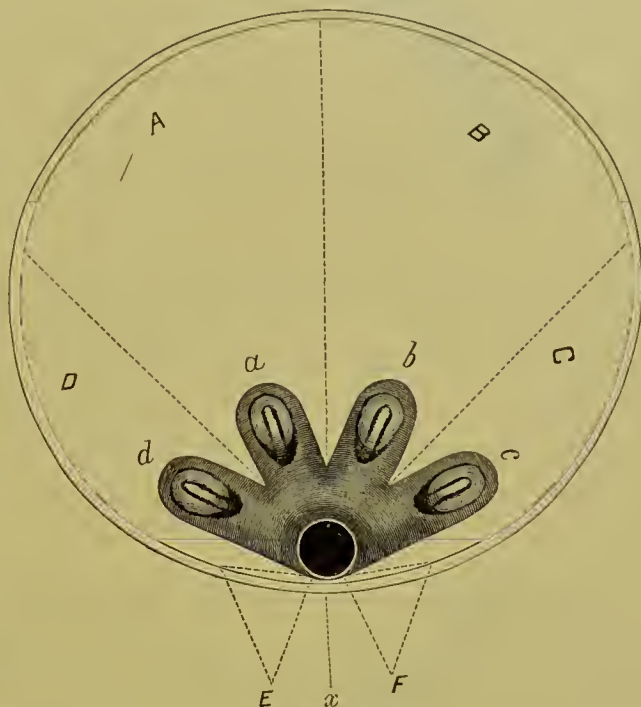


FIG. 20.—(Nitze.)

2. Beak turned to the left for 45° (position *b*) and pulled back to the internal urethral orifice, gliding over the fundus (this latter can only be accomplished by raising the funnel). Segment viewed = B.

3. Beak turned for 45° more to the left (*c*) and pushed again slowly forward to the posterior wall. The funnel is gently pressed to the left.† Segment examined = C.

* The motions which can be made with the cystoscope in the bladder are threefold: *a*. In the antero-posterior direction; that means in the direction of the longitudinal axis of the instrument. *b*. By turning the shaft around its longitudinal axis. (In these two motions the axis itself remains steady.) *c*. Changing the position of the axis itself by moving the funnel upward and downward or from one side to the other. By combining these latter motions we will get a kind of funnel-shaped ones.

† This latter manipulation will make visible the small strip F, on the opposite side also E, marked in the figure on each side of the instrument.

4. Beak turned for 135° to the right (*d*). Funnel also conducted toward this side. Cystoscope withdrawn to the internal urethral orifice. Portion viewed = D.

So far that portion of the bladder has been inspected which is situated above a plane put through the longitudinal axis of the instrument

transversely. It is the largest, and embraces the entire anterior wall, the vertex, and the upper larger portion of the posterior and the two lateral walls.

To view the portion below this plane, the beak is—

(B) Directed *downward* by turning it (from position *a* or *b*) 180° ; the funnel is pressed down, and the instrument pushed deep into the cavity of the bladder close to its anterior wall (Fig. 21).

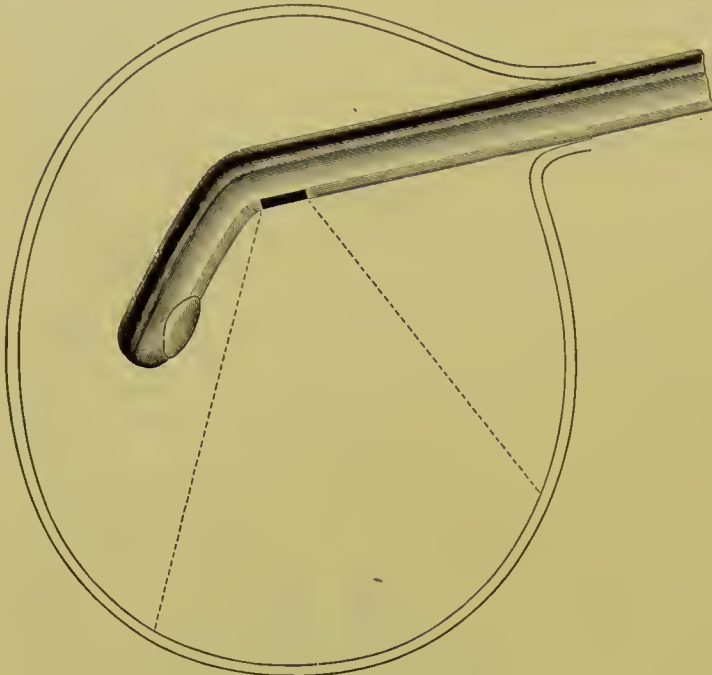


FIG. 21.—(Nitze.)

I deem it correct to give this rather elaborate and theoretical description here to prove that in the majority of cases we can really examine the *entire inner surface* of the bladder with cystoscope No. 1. (Only in exceptional cases we have to use, besides, Nos. 2 and 3, the former for the fundus in cases of marked hypertrophy of the prostate, the latter if the immediate neighborhood of the internal urethral orifice presents pathological conditions). It may easily impress the reader as if the examination "in praxi" is a difficult manoeuvre; but that is not at all so. It is by far simpler and easier. The above theoretical points are more for the beginner than for the experienced cystoscopist, to be sure that really the entire surface of the bladder had been inspected. The turning around the longitudinal axis for $22\frac{1}{2}^\circ$, 45° , 135° , etc., is also not to be taken literally. The size of the angle in which the field of vision appears is not exactly 45° , as represented in Fig. 20. In most cystoscopes it is 45° to 65° . Thus the border-strip of mucous membrane, examined in position *a*, will come into view for a second time in position *b*. The border-line of *d* will cover that of *a*, and so forth. In praxi, moreover, the positions described have to follow each other differently. The last (Fig. 21) has to

be the first. In other words, we at once direct the beak to the fundus of the bladder, "for it is this section of the bladder which contains or conceals for the most part those diseases which rank as 'obscure.' "The inferior zone of the bladder is to vesical endoscopy what the optic disk is to ophthalmoseopy, the most important area in the examination" (Fenwick). To complete the latter, we will then *afterward* direct our attention to the less interesting middle and superior zones, by quickly turning and moving the cystoscope in the other positions described above.

A few more general points have yet to be emphasized :

Make first examination always with the prism far away from the object. If, then, something has attracted special attention, approach it with the prism, but bear in mind the inversion and twisted appearance of certain pictures, and the nearer the prism the larger the object, and *vice versa*. The knob soldered to the upper brim of the funnel should be frequently touched during the examination, to be always informed where the object just observed is situated.

The distance between the prism and object is estimated by the space in which the beak has been moved forward from the internal urethral orifice into the bladder, by the position of the shaft, and by the amount

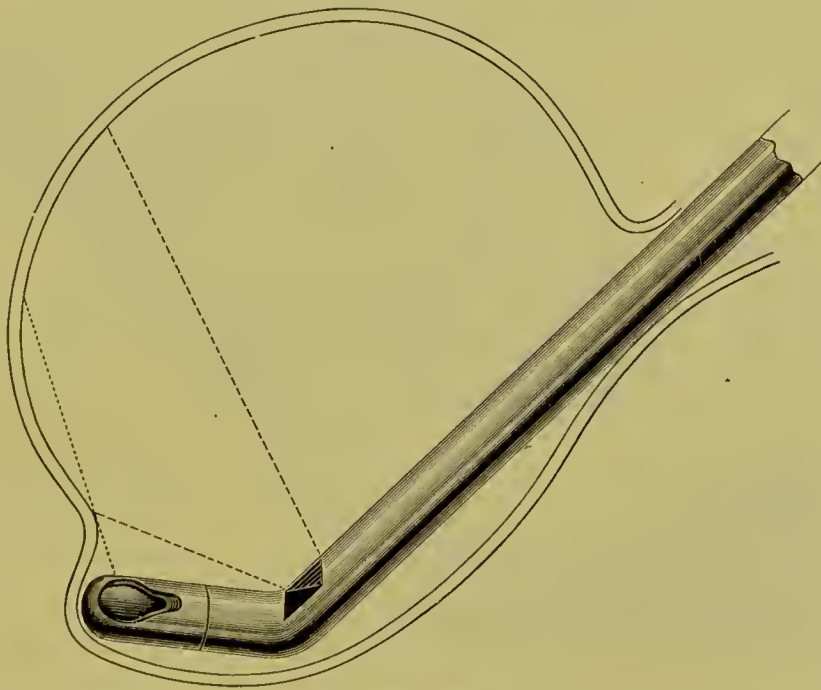


FIG. 22.—(Nitze.)

of light that is thrown on the field of vision. Difference of level is signified by a great difference in the degree of illumination of neighboring portions.

Size and shape of a prominent object (tumor, etc.) are diagnosed by the

size and shape of the shadows thrown upon the vesical wall in various positions of the lamp.

The moment when the surface of the lamp touches the mucous membrane is marked by *sudden* darkening and deep reddening of the field of vision (Fig. 22), also by the burning sensation soon experienced by the patient; then move beak in opposite direction, as done just before, and the former bright illumination will return.

Summary of Former Scattered Remarks with Reference to the Use of the Cystoscope in Patients with Hypertrophy of the Prostate.—1. If possible, use the irrigating cystoscope. Of course, the general surgical rule for this trouble must be strictly obeyed—namely, to press the handle gently down as far as possible before the beak is made to enter the bladder. The short (Mercier's) beak of the cystoscope is excellently fitted for this purpose.

2. Start a gentle irrigation while passing the prostatic portion of the urethra. If the caliber of the urethra is less than 25 French, introduce

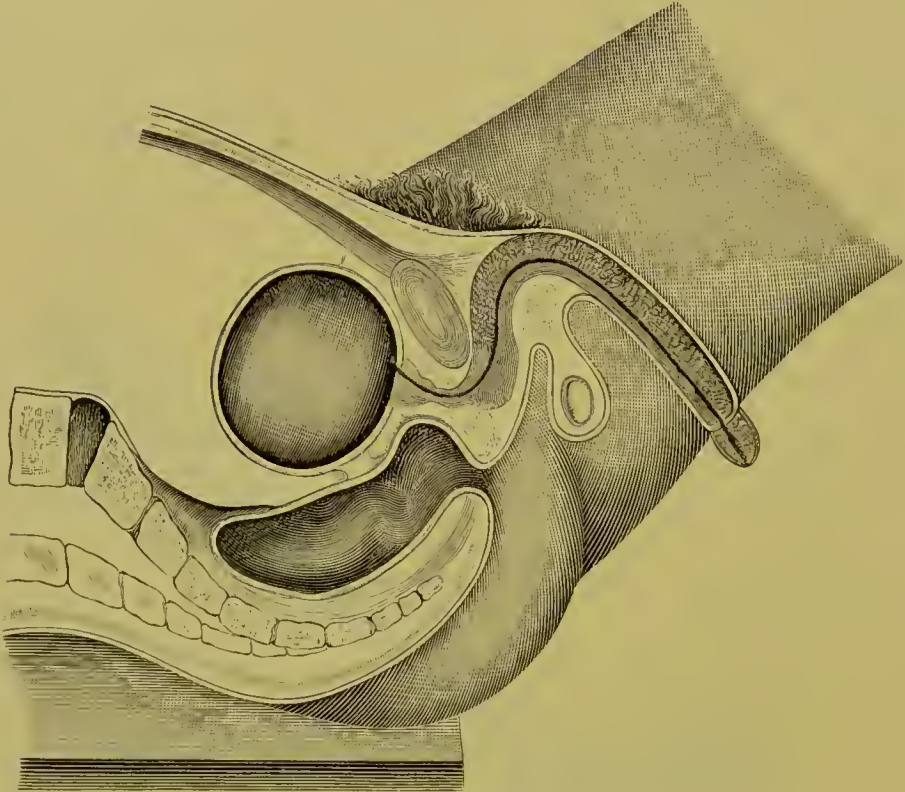


FIG. 23.—(Nitze.)

cystoscope No. 1 long, and just previously inject some glycerin into the posterior urethra. If this latter instrument must be used, a failure may be expected.* Bleeding is easily started when a solid instrument passes

* For quite exceptional cases we need a still longer instrument. As Nitze asserts, a cystoscope can be manufactured as long as 35 centimetres (equal to 13 $\frac{3}{4}$ inches). Its cali-

the prostatic portion. The blood settles on prism and lamp. The field of vision appears diffusely red.

3. The larger the prostate the more firmly is the instrument held in its changed equilibrium. The necessary funnel-shaped motions (see above)

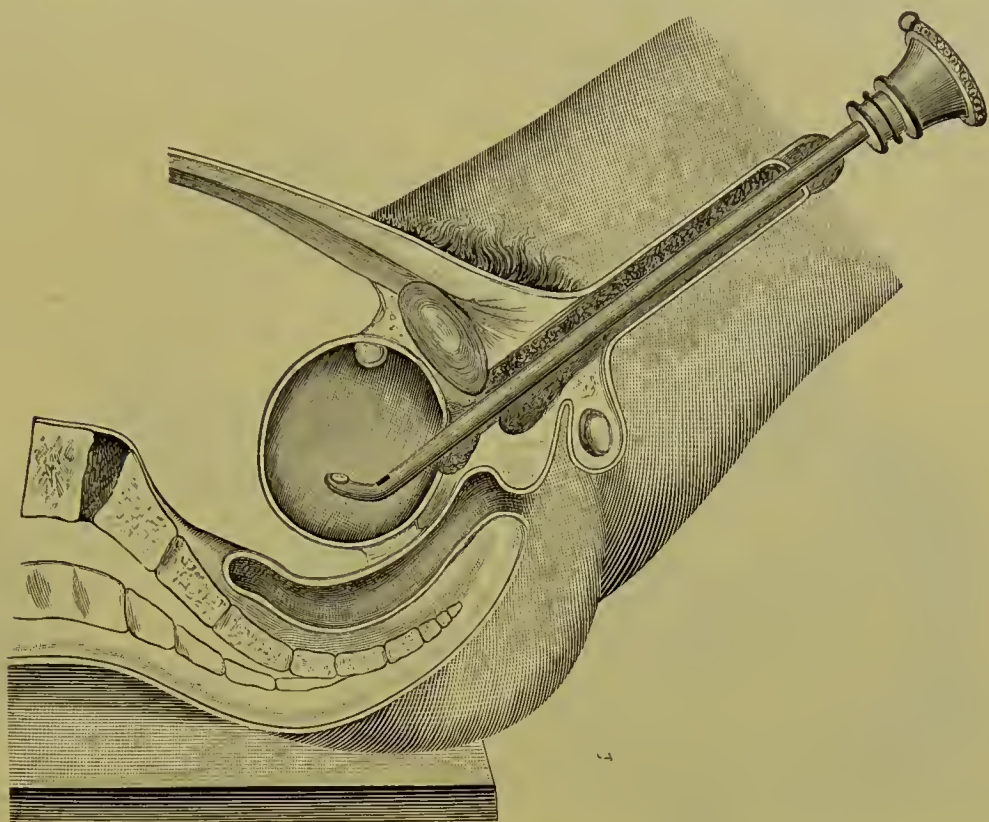


FIG. 24.—(Nitze.)

are in these cases less extensive, besides being more painful to the patient and quite tiresome for the cystoscopist. It is difficult to explore the bladder thoroughly. In obstinate cases narcosis should therefore be used. It will be a great help. In very pronounced cases we may need cystoscope Nos. 2 and 3.

(Every solid instrument (sound or catheter), if introduced through a normal male urethra, shortens the latter for about three quarters to one inch. This is caused by flattening the curve which the normal urethra makes in its way around the lower border of the symphysis (Fig. 23). This flattening depresses the prostate and stretches the ligamentum suspensorium penis (Fig. 24). Thus a double-armed lever is formed. The

ber has then, however, also to be increased, otherwise the illumination would be insufficient. (The note may find a place here that, on the other hand, a good cystoscope can be constructed for use in children as small as No. 16 French.) In such exceptional cases we should make it a rule to explore the urethra with a prostatic sound a few days previous to the examination, if this is feasible. It will tend to spare trouble to the patient and disappointment to the cystoscopist.

relative strength of its two arms determines the middle (equilibrium) position of the sound which was introduced and left to itself. In a normal bladder this position is such that the shaft does not touch the fundus, but forms with it an angle of about 20° , open posteriorly (Fig. 24). In cases of hypertrophy of the prostate the prostatic portion of the urethra is rigid, the ligamentum suspensorium penis, as in all older patients, less

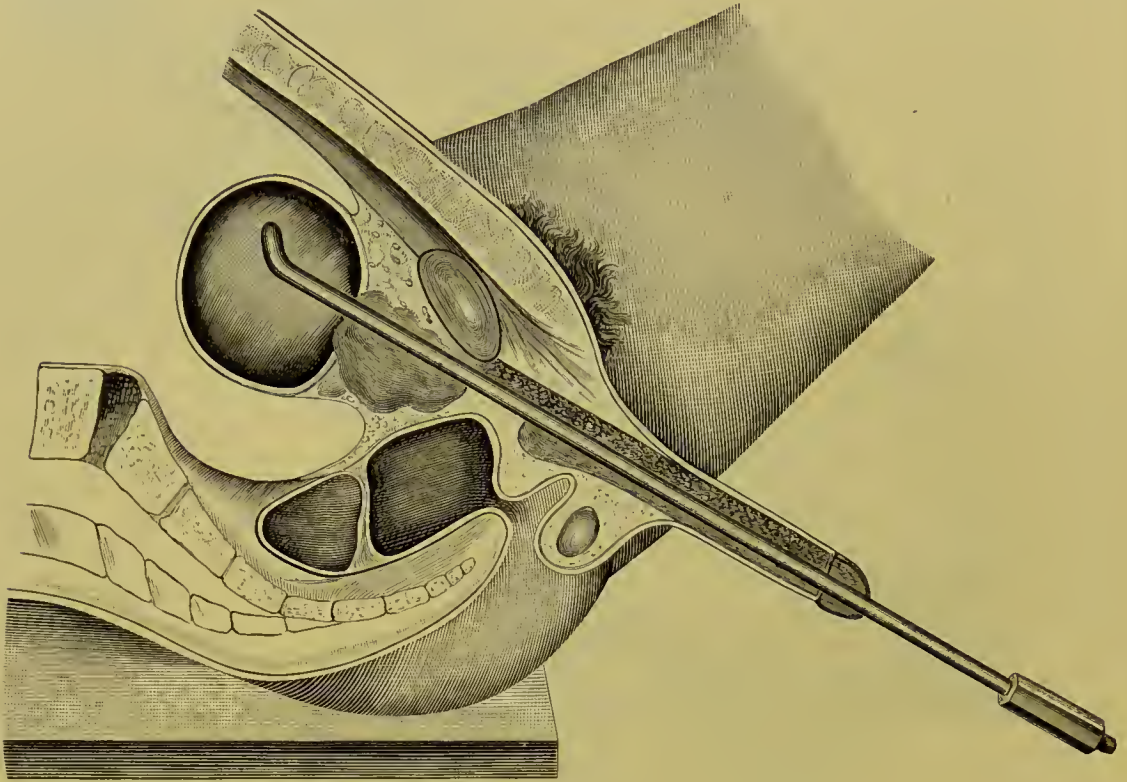


FIG. 25.—(Nitze.)

firm. Thus the equilibrium of the sound is changed, as demonstrated in Fig. 25. The axis of the latter runs parallel with that of the body, or is even deviating posteriorly.)

4. Be careful in estimating the size of the different lobes of the prostate, especially of the median. They can be observed with No. 1, lying in the shade. No. 2 illuminates them. The prism is near, the object therefore greatly magnified.

Cystoscopic Appearance of the Healthy Bladder.—To avoid grave mistakes in interpreting the pictures observed in the diseased bladder, the cystoscopist should first carefully study the normal viscus. Only if he gets no chance to inspect the interior of the healthy living bladder ought he to make use of the cadaver. The former is by far preferable. A number of important phenomena are to be seen only there.

The medical man interested in genito-urinary surgery, who once has the chance to leisurely explore the bladder surface with his eyes, no doubt

becomes an ardent admirer of this newest branch of surgical diagnosis. Not that the coloring (pale, yellowish-red, rarely pink) and surface of its mucous membrane (uneven, hilly, on account of the slightly projecting bundles of the detrusor muscle), or the fine ramifications of minutest blood-vessels, similar to those seen on the retina with the ophthalmoscope (Figs. 26, 27, and 29), or the peculiar picture of the fold of mucous membrane around the internal orifice of the urethra (Figs. 26 and 27*), will especially strike him; not that the rhythmic pulsation of the same spot of the wall, especially on the lateral sides of the bladder (transmission of the pulse of the external iliac artery), or the glistening bubble of filtered air at the vertex (Fig. 26), intentionally injected for easier localization of the latter, and slightly rolling up and down according to the displacement of the intra-abdominal organs during respiration, will astonish him so much.



FIG. 26.—(Nitze.)



FIG. 27.—(Nitze.)

Nay, it is the cystoscopic picture of the fundus of the bladder, the trigonum with the mouth of the ureters and their folds of mucous membrane, which will arouse his most intense interest. Nearly every surgeon will once have had the opportunity of observing the small fountains of urine emitted from the everted mouths of the ureters in congenital exstrophy of the bladder, or perhaps in a specially favorable case of vesico-vaginal fistula. Often he may have watched the same picture, after the bladder had been opened by the suprapubic incision and the patient put in Trendelenburg's posture, and have then even catheterized the small channels with ease. Yet it is like a revelation to watch this phenomenon under ordinary circumstances in the healthy living bladder which is filled with transparent fluid; to see the glycerin-like jets of urine, appearing intermittently about every thirty to sixty seconds, sometimes not oftener than every five to six minutes (and that in non-pathological cases), not simply

* Fig. 27 shows at the same time the cystoscopic picture of a benignant growth.

run down as in the congenitally or artificially opened viscus, but create, physiologically, sudden whirls, which last a few seconds and then slowly disperse in the clear medium.

When I observed this for the first time with the cystoscope (January, 1888), no mention had yet been made, in the very few articles bearing on cystoscopy, which had been published up to that time, with reference to the peculiar, physiological, intermittent motions of the mouth of the ureters, and their adjacent fold of mucous membrane. On April 9, 1888, I expressed myself with reference to this observation in my paper "On Cystoscopy and the New Cystoscope of Nitze and Leiter" (New York Medical Journal, April 21, 1888), as follows: "In watching more closely the orifice of either of the ureters for some time, I have easily been able to see how the urine entered the bladder at intervals of from thirty to sixty seconds. I have been enabled to do so by the whirls which the urine—viz., a solution of salts—produced in the water that had been injected into the bladder (we can see the same arise at any time when we pour urine into a test-tube filled with water). On the same occasion I observed quite an interesting physiological phenomenon, which is not mentioned, as far as I have seen, in any one of our hand-books on physiology. It is well known that the urine enters the bladder at intervals with a rush, and so much so that it forms a real little fountain when the bladder is opened by incision. The urine is pressed forward, firstly, by the *vis a tergo*; secondly, by the difference in pressure between the pelvis of the kidney and the cavity of the bladder; and, thirdly, by the peristaltic contractions of the ureteral muscles. Now, as there are in the walls of the ureter more muscular fibers running longitudinally than transversely, the orifice of the ureter, and with it the elevation of the mucous membrane in which it ends, is drawn *inward* at the end of each conveyance of urine into the bladder, the orifice and its nearest adjacent parts then taking the shape of a funnel. After a few seconds it returns to its former position." Two years later I said (Annals of Surgery, June, 1890): "When the urine begins to enter the bladder, the mouths of the ureters with their elevation of mucous membrane keep their position, or are sometimes pressed a little forward. Only, at the end of each conveyance of urine into the bladder the orifice is drawn inward, and assumes with its nearest adjacent parts the shape of a funnel. As soon as the last drop of urine has been passed into the bladder the mouths of the ureters return to their former place." I mention this, because Nitze has seen the different phases of this phenomenon in rather the opposite succession: (*loc. cit.* page 147) "The mouth of the ureter first slowly contracts to the size of a very small groove, and then again gradually enlarges to its former size, at this moment suddenly giving exit to the urine; it then remains in this middle position for a short while, until

the recurrence of the same movement determines a repetition of the phenomena." Fenwick states (*loc. cit.* pages 82, 83): "If one of these orifices be watched carefully, the curious phenomenon of efflux will be seen. The little slit will suddenly gape and a tiny swirl of fluid will be emitted. . . . Not infrequently the observer will notice a rhythmic contraction in the ureteral orifice and the surrounding bladder wall. Should the orifice be projecting inward as a cone, the apex of the body will alternately recede and protrude." I think that I am not mistaken in assuming that the funnel-like retraction and contraction of the ureteral "orifice" generally immediately follows, not precedes, the jet of urine. It announces its end, not the beginning.*

Cystoscopic Appearance of the Diseased Bladder.—Nitze gives a very good *résumé* of the capabilities of the cystoscope in pathological conditions of the bladder. The present electric illumination of the bladder, he says, gives us the means of establishing a strict differential diagnosis between the various forms of catarrh of the bladder; it is easy to see with it ulcerations, to demonstrate diverticula, to find and localize foreign bodies; it seems almost unnecessary to mention how plainly we can now see stones, make out their number, size, shape, and mobility, and percuss them with the beak of the instrument; how encysted stones, too, will not escape the examining eye; especially the diagnosis of tumors of the bladder is now easy, and can be made early.

The rapidly following development of this new method, which is illustrated by manifold brilliant results in clearing up previously obscure urinary diseases with electric illumination of the bladder, is laid down in the already comparatively large literature on cystoscopy. I would by far trespass the limits of this article—which is mainly written to illustrate and describe the best and most improved instruments, the practical application of the cystoscope for diagnostic and other purposes, as well as its limitations—should I try to enumerate everything of interest that has so far been seen in the bladder, and described in published accounts. It would, besides, be of no intrinsic value. Certainly it is not exaggerated to state that the results obtained by cystoscopists of nearly every nationality within the last four years sustain Nitze's original statement and predictions in every particular.

The brief report of a few cases of vesical disease may illustrate the different chapters in their cystoscopic appearance:

1. *Catarrh*.—As in other organs, catarrh of the bladder manifests

* The ureteral "cone," this elevation of mucous membrane produced by the oblique direction of the lower end of the ureter in penetrating the vesical wall, often shows one or more rather slow peristaltic contractions which precede the efflux of urine. If these contractions are confined to the immediate neighborhood of the mouth of the ureter, the latter is pushed forward (erecting) before the whirl of urine appears.

itself by redness and œdematous swelling of the mucous membrane, and in the production of a catarrhal secretion. The pictures show a great variety, and yet do not distinctly differ from each other, in accordance with the various degrees of cystitis, so much the more as the latter is so often combined with and especially dependent upon other vesical troubles.

a. Acute: Symptoms well known. Cystoscopy not indicated. Pictures only of pathologico-anatomical interest; especially studied in gonorrhœal cystitis by Finger (Wiener medizinische Presse, 1880, page 997). Mucous membrane, in proportion to the extent and intensity of the process, more or less swollen and turgescient, especially at the neck of the bladder, is marked with anastomosing, greatly dilated vessels (injection thus irregular, circumscribed, with interposed large healthy portions). In very acute cases the mucous membrane is studded with hæmorrhagic spots, streaks, or blotches (ecchymoses), or it appears of a uniform dark-red color. Epithelium scaled off, either collected in clumps or in long, thready streamers, which float in the contents of the viscus. The diseased surface bleeds if touched with the beak of an instrument. Other cases of acute cystitis have very nearly the same appearance, only the extent is sometimes more marked.*

b. Hæmorrhagic: A subacute, formerly not well-known, but important form of cystitis. Symptoms often precisely similar to those evoked by growth in the bladder; obstinate to cure. Character usually benign. According to Fenwick, "a certain form of hæmorrhagic cystitis precedes the formation of that stunted nodular carcinoma of the mucous membrane which accompanies interstitial malignant growth of the vesical wall" (compare the precancerous stage of the mucous membrane).

c. Chronic: Great variety of characteristics, according to the degree of the attending inflammation. If that be slight, the mucous membrane is strikingly pale, nowhere reddened, but thickened. After short irrigation only a few clumps of muco-pus are seen to adhere to its surface. In other cases the color of the mucous membrane is dark gray, probably resulting from often-recurring inflammatory attacks which had been marked by sub- and intra-mucous sugillations. Here rugæ are often swollen, of velvety appearance, especially on their surface, running parallel in the shape of longitudinal thick folds. They often appear circumscribed in irregular groups; strips of sticky mucus adhere to their surface and float in the fluid. They are easily mistaken for a tumor when near the internal urethral orifice (magnified) and inspected from the side. If an acute attack is grafted on such a chronic form, mainly the top of these folds and the portions around the neck of the bladder appear deep

* If pathognomonic symptoms are well defined, the use of the cystoscope is here as well prohibited as that of a catheter or sound.

red. As just stated, the cystoscopic pictures of chronic cystitis show the greatest variety. Their study is very necessary to develop a skilled cystoscopist.

NOTE.—In many patients, male and female, who mainly complained of frequent micturition (every ten to thirty to sixty minutes) and tormenting tenesmus, having besides clear urine of low specific gravity with a large amount of bladder epithelium, sometimes of all the three layers, the cystoscope always revealed the same condition, namely, perfectly normal bladder; from the injected trigonum to the neck a continuous dense network of dilated capillaries. Whether this be primary or secondary, I should at present not venture to decide.

d. Ulcerative: (Non-tubercular.) Very rare, only occurring in very grave forms of vesical disease. Bladder always very irritable, barely holding two ounces. Cystoscopy therefore often impossible.

CASE.—Girl, seventeen. Enuresis nocturna, since childhood; great vesical, painless irritability (capacity, two to three ounces); hæmaturia, formerly intermittent, lately continuous. Urine ammoniacal. No tuberculous history. Cystoscopy: Many irregular deep-red patches of a granulating surface, partially covered with deposits of snow-white mucus spread over the whole interior of the bladder, especially numerous on the right side and vertex, still more in the fundus around the right ureteral orifice; intermediate mucous membrane slightly hyperæmic, near the neck of the bladder velvety; otherwise not materially changed. No bleeding during examination. Examination rather hurriedly performed, as the four ounces of fluid originally injected under pressure continuously flow away again alongside the cystoscope. Microscopical examination of deposit in urine seemed to reveal sarcomatous elements. Probable diagnosis: multiple sarcoma of the bladder. Soon afterward the surgeon who had brought the patient to my office performed suprapubic cystotomy, and carefully scraped the bladder as thoroughly as possible. Report of pathologist with reference to the removed scraps of tissue also in favor of sarcoma. Subsequent observation, however, excluded a new growth. Diagnosis (by exclusion): chronic non-tuberculous, ulcerative cystitis.

2. *Tuberculosis.*—*a.* Tubercular cystitis without ulceration. Pathognomonic cystoscopic picture of this trouble has not yet been definitely established. If tubercle bacilli have been found in the urine before cystoscopy is tried,* a localized hyperæmic spot of the vesical mucous membrane seen through the cystoscope has to be diagnosticated as being most probably one of tuberculous character (tuberculous infiltration).

An interesting case of tubercular cystitis, diagnosed in its beginning cystoscopically, is reported by Burckhardt.

Man, thirty-seven. Chronic gonorrhœal urethritis, with following cystitis (for nine months). No gonococci, no tubercle bacilli. Local treatment with-

* They will be by far easier found, even in a relatively clear urine, and, if present in a very minute quantity, by the centrifugal method of Stenbeek, modified by von Frisch (Zur Diagnose der tuberkulösen Erkrankungen der Urogenitalsystems, Internat. klin. Rundschau, 1891, Nos. 28-30; also, Wiener klin. Wochenschr., 1891, No. 23, and Berl. klin. Wochenschr., 1892, No. 22, p. 531).

out improvement. Cystoscopy: Mucous membrane hyperæmic, dotted with numerous minute ecchymoses; their circumference dark red (Fig. 28). Many anastomosing vessels. Tubercular cystitis suspected. Diagnosis later corroborated, as tubercular epididymitis develops bilaterally, and necessitates castration.

It is to be hoped that such cases, if made out in this manner, will henceforth be published in their cystoscopic detail. Only then we may hope to diagnose the tubercular cystitis with the cystoscope, "even if no tubercle bacilli had been found in the urine."

b. Ulceration.—If no catarrh of the bladder is present, one or more characteristic ulcerations will be seen upon an otherwise perfectly healthy mucous membrane.

CASE.—Man, forty-five; sick twelve years. Intermittent hæmaturia and increasing trouble since two years and a half. Suppurating right kidney. Tubercle bacilli abundant. Is the bladder also involved? Cystoscopy, April, 1890: Immediately above the swollen mouth of the right ureter and its elevation of mucous membrane an ulcerated spot of about the size of two silver dollars. Purplish-red, broad elevations (evidently the inflamed fibers of the detrusor muscle) cross each other in different directions. Small particles of snowy, shining mucus adherent to their surface float in the fluid. Depressions between these elevations of a lighter hue, also covered with mucous flakes. In between them numerous very small and larger sessile growths of grayish coloring, a few about as large as a pin's head, undoubtedly *miliary tubercles*. On one spot a small, rhomboid-shaped, dark-red (hæmorrhagic) spot. The entire other inner surface of the bladder perfectly normal, of grayish-white color, rather anæmic, corresponding with the condition of the patient.—(AUTHOR.)

In all these cases the cystoscope has to be used with great gentleness and care. The trouble of patients who suffer from tuberculous vesical disease is sometimes greatly aggravated by introducing a solid instrument into the bladder. If the diagnosis is clear, cystoscopy is contra-indicated.

Hypertrophy of the Prostate, especially its Median Lobe.—*Trabecular bladder (vessie à colonnes).*—Although cystoscope No. 1 does not "illuminate" the internal urethral orifice, still we can see with it a swollen prostate gland, and after a sufficient experience estimate its size. On the fundus, or rather between it and the internal urethral orifice, a small portion of the gland—in the picture a massy projection situated between prism and lamp—is of high red coloring, on account of the oblique direction of the rays. The other part, especially the prominent median lobe, is lying in the shade.* Frequently we see the internal urethral orifice surrounded by a collarette of the hypertrophied gland. If it be sore, I have often seen blood oozing from its surface in a continuous small, shadowed stream, or a greatly magnified coagulum, adherent to its surface, streaming in the fluid.

* With cystoscope No. 2 all three lobes can be illuminated. (Fig. 29.)

Very important for diagnosing hypertrophy of the prostate is the (diaphanoscopic) picture of the fold of mucous membrane around the upper circumference of the internal orifice of the urethra, to be briefly called "inner fold." Under ordinary circumstances this fold presents itself at the moment the prism enters the bladder, in the shape of a sharply cut half-moon. On account of the peculiarities of the optic apparatus its picture is seen inverted, and therefore observed in the lower half of the cystoscopic picture, its concavity pointing upward (Fig. 26). If the prostate is in the state of hypertrophy, this neatly and everywhere equally outlined thin fold is thickened, irregular, and nodulous. The gentle concave curve is represented by a deep angular notch with two upwardly divergent thick folds (Fig. 30).

Especially prominent in the picture, but greatly enlarged, appears the median lobe of the prostate gland.

CASE.—Man, seventy. Relies entirely upon catheter, which has frequently to be passed. Passage attended by difficulty and pain. Urine clear; no albumin, no casts; great local distress. Cystoscopy: Slightly hypertrophied median lobe of about one half to three quarters the size of the third phalanx of the middle finger, easily diagnosticated; the bladder presents a *vessie à colonnes* in a most beautiful manner (Figs. 30, 31, and 32). On suprapubic cystotomy, performed by another surgeon, the third lobe was found as diagnosticated.—(AUTHOR.)



FIG. 31. (Nitze.)

Diverticulum.—Its formation is closely connected with trabecular hypertrophy; therefore mostly found in such cases, solitary or multiple, sometimes in all stages of development (Fig. 32).

CASE.—Man, sixty-four; diabetic, hypertrophy of the prostate, chronic catarrh. Cystoscopy: All symptoms of chronic catarrh; trabecular bladder. A little above the mouth of the left ureter a large dark spot of about the size of a five-cent piece; its lining mucous membrane wrinkled; no more dark spots visible. Light of cystoscope turned off, and tip posted right in front of this spot, gently pushed forward. It evidently enters a cavity, but touches no concrement. Diagnosis: Diverticulum (Fig. 33).* Two years later epicystotomy becomes imperative, and shows a large diverticulum at the diagnosticated spot, (then) filled with phosphatic *débris*.—(AUTHOR.)

* The stones, as seen in the picture, were not present in this case. (Cf. "Encysted Stones.")

Foreign Bodies.—It is self-understood that foreign bodies, not to be detected by the sound even in the hands of a well-experienced surgeon, can not only be seen but localized.

CASE I.—Man, fifty-four; tabetic, who catheterized himself. Having done so one night, patient fell asleep. On awakening, catheter nowhere to be found. Entered von Dittel's clinic. Gruenfeld's endoscope, tried first, gave negative result. On using the old Nitze-Leiter endoscope, December 16, 1883, there came

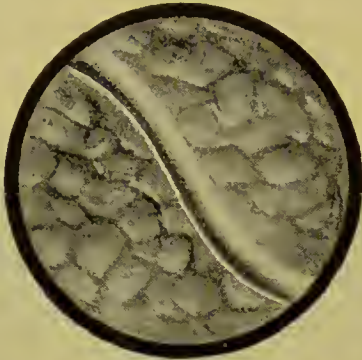


FIG. 34.



FIG. 35.

into view "a symmetric, elongated, yellowish body, somewhat like an 'ascaris lumbricoides,' which was evidently the catheter covered with a yellow urinary deposit" (Fig. 34). In one spot it was seen as reflected over itself (Fig. 35). It was extracted with a lithotrite.

CASE II.—Lad, eighteen; had introduced a medium-sized pin, head forward, into his urethra. Nine days later, on account of great pain, admitted to Nicoladoni's clinic. Different instruments failed to detect the body. By means of the old-shaped cystoscope, pin plainly seen fixed in the right part of the anterior wall, close to the vertex. It cast a shadow on the opposite wall of the bladder, and could be well demonstrated to a large assembly (Fig. 36).

CASE III.—Lady, thirty-five; ovariectomy, by Martin, of Berlin, April, 1885; pedicle and vessels tied with silk. Recovery. Two years later, serious sickness. At last an intraperitoneal abscess perforated into the bladder. Shortly afterward stone discovered. A portion removed with the lithotrite. Patient then evacuated a silk thread. One month later, sound demonstrated presence of stone, left at the first operation; crushed by Nitze, August 18th. A few silk ligatures passed and extracted. Two days later, neither sound nor lithotrite could detect anything further in the bladder. Cystoscopy (Nitze): On the left side another ligature discovered. "One of the ends projected out from the walls, glistening in the brilliant illumination of the light; a smaller and shorter end was found below, and the middle, or loop and knot part, was buried in a rose-colored granulation-papilla, which sprang from a well-marked, crater-like depression in the mucous membrane (Fig. 37). The longer thread threw a distinct shadow on the subjacent surface, which traveled to and fro according to the movements of the lamp. The ligature had exactly the same appearance as the one removed the previous day in the blades of the lithotrite. The condition thus being diagnosticated and localized, another thread two and a half inches long was cleverly caught with the blade of the lithotrite and removed by Nitze. The knot with the shorter end remained in the wall, as seen again through the cysto-

scope. Patient had then to leave for America. Condition explained to her. November 11th, the same year, a small stone was extracted by Prof. Gross, of Philadelphia, hanging on that silk thread which had to be left *in situ* by Nitze three months previously. Entire recovery.

Stones.—It seems almost unnecessary to mention that we can plainly see stones in the bladder, make out their size, shape, and mobility, and percuss them with the beak of the cystoscope, by the guidance of our eyes.

CASE.—Man, fifty-three; short-lasting lumbar pain on left side, in fall of 1886. One year later developed symptoms of stone, but no hæmaturia, no stoppage of flow of urine. Repeated examination by a very able surgeon failed to detect stone. Condition getting steadily worse, patient was sent to me for cystoscopy. On patient's urgent request, cystoscope at once introduced. In the fundus an oval-shaped, brownish body covered with white spots (evidently phosphatic deposits) of the size of an almond at once detected. It lay in the pouch behind the enlarged prostate, and threw a distinct shadow upon the opposite wall of the bladder. Light turned off, and body touched with tip of instrument. Unmistakable click. Suprapubic lithotomy. Stone easily removed. It presented the characteristics as seen with the cystoscope.—(AUTHOR). A very good cystoscopic picture of stone is given by Nitze (Fig. 38).

Encysted Stones.—Fenwick reports the following case (Intern. Med. Annual, 1892, page 119):

Man, sixty; symptoms of an enlarged prostate, complicated with stone, present for many months. Sounding, on four separate occasions, with and without ether, resultless. Cystoscopy: A "pile of small concretions lodged deep in a sac" (Fig. 33). A small-jawed lithotrite was guided to the mouth of the pouch and the beak edged in; calculi were seized, pulled out and crushed. Complete recovery. Cystoscopy one year after: Sac greatly contracted; free from stone.

Tumors.—In establishing their "early diagnosis" cystoscopy celebrates its greatest triumph. Many cases have been reported where the cystoscope easily revealed this formerly obscure trouble. (Cf. Albarran, *loc. cit.*, page 422 and following pages.)

CASE.—Man, fifty-three; for six months pain in glans, frequent forcible micturition, continuous hæmaturia. Cystoscopy: Round sessile growth with an uneven surface, not unlike a large, round strawberry, on the left wall of the bladder about an inch above the mouth of the left ureter (Fig. 39).* Blood oozed out of its surface. Bladder otherwise healthy; symptoms of slight catarrh. Diagnosis: Cancerous sessile tumor of the bladder. Suprapubic cystotomy, March 25, 1890: Growth on the spot localized before, with all the characteristics as diagnosticated with the cystoscope; cut out with knife, base burned with Paquelin. Recovery. No recurrence to date (AUTHOR).



FIG. 39.

* Picture corresponded exactly to the accompanying cut, which is taken from Von Antal, *loc. cit.*, page 406.

NOTE.—Fenwick believes he has seen and found a peculiar condition of the vesical mucous membrane which he calls "precancerous." Four interesting cases are reported for illustration. He rightly advises the cystoscopist to be guarded with his report in cases where a projecting tumor or a very definite change of the mucous membrane is absent, but the obstinate character of the symptoms arouses suspicion. The cystoscopist "will be acting wisely by simply declaring the bladder to be free from any projecting growth or tumor, and by stating that operative interference is not at once called for. At the same time, he will do well to hint that such conditions of mucous membrane are likely to degenerate into carcinoma, and that a re-examination at the end of three months is advisable" (*loc. cit.*, p. 160).

How greatly such exact diagnosis * at once facilitates both prognosis and treatment of bladder diseases, is obvious. The more thorough knowledge of the various forms of catarrh of the bladder will demand a modified treatment. The diagnosis of ulcerations of the wall of the bladder, especially those of a tuberculous nature, will force the knife into the surgeon's hands to perform suprapubic cystotomy, to scrape the ulcers under the guidance of the eye, and burn their base, or to make a radical extirpation which includes the wall of the bladder. Foreign bodies, plainly localized, can be removed with absolute certainty by a proper method. If, after litholapaxy, any detritus remains in the bladder, the cystoscope will find and localize it, and therewith greatly facilitate its removal. The only plausible reproach which has been addressed to litholapaxy has thus lost its foundation. Litholapaxy, with the help of cystoscopy, will forever rank highly among operations for stone. If a catheter with a curvature adapted to the locality of a diverticulum is introduced into the bladder, it may be washed out, and the catarrh caused by its presence may be thus improved. If a diverticulum has been seen, the bladder must be very carefully distended for suprapubic incision.

The treatment of tumors of the bladder has been especially benefited by cystoscopy. "Early diagnosis and removal" characterize the progress in this class of cases. To remove benignant pedunculated growths, Nitze proposed not to incise the bladder, but to crush the growth when localized with a long forceps introduced through the urethra. The curvature of the forceps must correspond with the insertion of the growth.† The operation may be performed in one sitting or more. The result will be easily controlled by repeating cystoscopy after some time. Von Antal and Fenwick have successfully operated according to this method; the tumors should be torn off, however, not crushed (Von Antal). In view of the continuously vanishing dangers of epicystotomy, and the sometimes can-

* We may rightly presume that the near future will define the cystoscopic picture of beginning tubercular cystitis, and probably that of syphilitic condition of the mucous membrane.

† G. G. Hopkins, of Brooklyn, has constructed a new curette for the male bladder, which, as it seems, can be well used for this purpose (Brooklyn Med. Jour., January, 1890).

cerous base of an even small, seemingly benign, villous growth, this latter operation will, in most cases of this kind, be the preferable interference. The removal of growths through the urethra should be confined to polypi. Still, it seems that the strict visual diagnosis may in the future allow operative interference by way of the urethra in many instances. Nitze's operating cystoscope (not yet finished) is the latest and boldest outcome in this direction. With its aid we may look forward to be able to carry on intravesical treatment without any cutting operation, under the direct guidance of our eyes.

Certainly it has been sufficiently established to-day, that if any doubt exists of the diagnosis in a case of vesical disease, and the three cardinal conditions which enable a cystoscopic examination to be made are fulfilled, it is the duty of the attending physician to submit his patient as early as possible to this ocular inspection. This for the same reasons as would lead him to use a mirror to look at the interior of the larynx, eye, nose, or ear, in their respective disorders.

Visual Fallacies of the Cystoscope, and how they may be avoided.—The fact must be emphasized, that the cystoscopic diagnosis in bladder diseases is not at all always easily made. Cystoscopy requires *in praxi* a great deal of patience, and much experience, in order to avoid mistakes. "It is perfectly true," says Fenwick (*loc. cit.*, page 93), "that a novice may recognize a typical growth or a glistening stone without difficulty, but it is also equally true that the inexperienced cystoscopist will be readily and more often deceived by the perplexing appearance which the mucous membrane is wont to assume under the varying conditions of relaxation, congestion, extravasation, and infiltration, and may be tempted to interfere, operatively, to his own and the patient's detriment, under the belief that he has to deal with a growth, when no such morbid condition is present." The above-given rule should also be borne in mind, always to make first a careful general examination, and let cystoscopy be the *last* help in the attempt at getting down to a correct and well-sustained diagnosis.*

Here are a few selected examples for the beginner, as well as for him who uses the cystoscope without a previous general examination:

The beginner will easily mistake the taggy shreds of necrotic tissue,

* To avoid mistakes in performing cystoscopy, the important peculiarities of the optic apparatus should be closely studied: 1. In moving, for instance, the cystoscope from the internal urethral orifice toward the posterior wall of the bladder, the different areas appear in the opposite direction. They enter the field of vision at the beak and move toward the observer. 2. If the beak is held parallel to the fundus of the bladder, objects, which really run transversely from the right to the left, appear in the cystoscopic picture to run from upward down, and those the longest dimension of which passes from the front backward, appear to run in the transverse diameter (for particulars, see Nitze, *loc. cit.*, pages 52-56). 3. If the prism is moved near to the object, the latter is magnified; if it is withdrawn, the opposite effect is produced.

hanging at the edge of a tuberculous ulcer and floating in the fluid, for a polypus, without at all noting the ulcer, especially if the prism is brought close to it. But the experienced and careful cystoscopist has probably found, in a previous examination, tuberculosis of the testicles, or an enlarged kidney, or tubercle bacilli in the urine, or such detritus under the microscope, as will lead him to suspect the existence of an ulcer, and thus make him look out for it.

Again, the beginner may take a very projecting ureteral cone, or a prolapse of the ureter, for a sessile growth. But if the prism be carried near to the latter, this growth is found to be entirely transparent, and on careful inspection it will be seen that out of one spot of its perfectly round and smooth surface a whirl of urine will suddenly be expelled. The pathognomonic symptoms of the ureteral cone are, "that its position corresponds to the postero-external angle of the trigone; that the summit is slightly flattened, depressed, and occupied by a small orifice, whence tiny jets of glycerin-like fluid issue at various intervals; and, moreover, that the apex not infrequently protrudes and recedes rhythmically" (Fenwick, *loc. cit.*, page 97). . . . The beginner will take an incrustated growth for a stone—a touch with the beak will generally dispel all doubt. . . . He will be apt, in seeing the picture of the enlarged median lobe of the prostate, to diagnose a benign or malignant growth in this position; . . . or, in observing the elongated, oval, or roundish elevation, of a deep-red, gelatinous aspect, caused by a submucous hæmorrhage, to diagnose epithelioma, being unaware of the importance of the differently shaped hæmorrhagic spots so often seen in the neighborhood of the former. . . . He will be puzzled by a deposit of coagulated blood around one of the ureteral cones, while the experienced will take it as a hint at hæmaturia of renal origin, most probably on the same side.*

Success will also not be with him if he only works with cystoscope No. 1, and the just injected clear fluid turns murky at once after a long-continued irrigation, or is found to be so as soon as the cystoscope has entered the bladder. In such a case the experienced man at once suspects kidney trouble, will exchange the ordinary for the irrigating cystoscope, and watch, after a quick glance at the interior of the bladder, the ureteral orifices. Most probably pain in one lumbar region or a swelling there, already perceptible to palpation, will guide him on which side to look first.

Of course, an infiltrated spot in the wall of a bladder which can not be properly distended, or greatly hypertrophied and easily bleeding

* The above-quoted pitfalls have all once puzzled the author. A few more are enumerated by Fenwick in his book, selected from the immense cystoscopic material which came under his observation.

rugæ in a case of localized chronic catarrh, will also sometimes mislead the well-trained eye, and induce one to diagnosticate a tumor where the suprapubic incision will merely show infiltration. Also many other mistakes may occur. But they will become rarer with increasing experience; and if, nevertheless, they still occur, the physician may console himself with the reflection that mistakes occur just as often and as easily in the other and older branches of surgical diagnosis.

Cystoscopy with Reference to Kidney Diseases.—That the diagnostic capabilities of the cystoscope are not limited to diseases of the bladder, but extend in many cases with admirable exactness also to those of the kidney, is an established fact. Not only can we with its help often localize the seat of the trouble—negative vesical evidence giving a positive diagnosis of renal disease—or distinguish whether there are two working kidneys, whether both are affected or only one, and then which of the two. Nay, the cystoscope gives us the means in certain cases to even go one step further—to determine whether the other kidney already is doing the work for the one which is diseased.

All this is accomplished by observing the character of the jets of urine at the ureteral orifices (transparency, color) and timing their frequency and duration, and also by noting the position, shape, and injection of the ureteral orifice itself (now and then with its fold of mucous membrane) in comparison with that of its fellow.

Under ordinary circumstances it is not difficult to determine whether the urine propelled from the ureteral orifices is clear, murky (purulent), or bloody. We simply have to place our prism just opposite and comparatively close to the mouth of the ureter and then carefully watch.* Some experience and patience, a quiet hand, and close attention are all that is needed. But, as mentioned above, this task at once grows more difficult, if the injected clear water rapidly becomes turbid. The inspection can then only be effected by means of the irrigating cystoscope.

A few cases may illustrate this:

1. *Renal Hæmaturia.*

CASE I.—Female, forty-six; painless hæmaturia of twelve months' duration. Cystoscopy, made at the time of bleeding: Bladder perfectly healthy. In watching the left ureteral orifice, a red, rapidly propelled whirl was seen to cross the prism and slowly mix with the transparent water, slightly coloring the same. After a short while the phenomenon reappeared. Diagnosis: Unilateral renal hæmaturia; according to the symptoms, evidently caused by a new growth. Nephrectomy proposed and declined. The patient died not long afterward after an abundant hæmorrhage.—(AUTHOR.)

CASE II.—Man, thirty; intermittent hæmaturia since two years. Urine

* Even with the strongest eyes a close watch of a ureteral orifice lasting longer than a few minutes (five to six) is impossible. The eyes get tired, and vision is blurred.

often more bloody toward the finish. Cystoscopy: "The entire bladder was healthy. I was just giving up the examination in despair, when I saw a stream of brightish blood shoot right across the prism. Keeping the instrument fixed, I waited until the medium became clear again, and then I found that I was

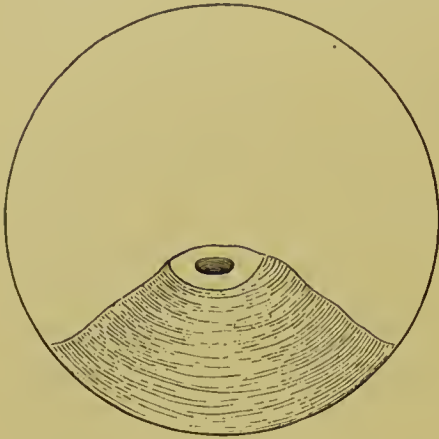


FIG. 40.



FIG. 41.

watching the orifice of the right ureter. In another second a jet of bloody urine burst from the tiny opening, and, after forming many rings, it paled by diffusion and disappeared, only to be replaced by a successor (Figs. 40, 41). The right renal source of the hæmorrhage was at once indicated" (Fenwick,* *loc. cit.*, page 93).

2. Renal Pyuria.

CASE I.—Lady, forty-five; cloudy urine for years, lately thick. Since a few days high fever. Tumor palpable in left groin. Cystoscopy under irrigation: Prism turned to the left, and murky fluid allowed to run off while hand-syringe threw in short jets of clear water. The fog lifted; left ureteral opening clearly perceived. Out of it, nearly at the same moment, a forcible eruption of a snowy-white, milky fluid. Spurting forward into the medium, contained in the bladder, in the shape of a fire-sheaf, the first rather thick mass at once dispersed and was dissolved into myriads of minutest snowflakes, which slowly came down and at once put a stop to all further examination. Manœuvre repeated with same result. Jets descend frequently. Urine of right kidney clear. Diagnosis: Left suppurating kidney, probably stone in pelvis. Nephrotomy, later nephrectomy. Perfect recovery. Specimen: Pyonephrotic kidney with a large stone.—(AUTHOR.)

CASE II.—Lady, forty-five. May, 1887, nephrotomy for left (floating) cystic, partially suppurating kidney. Condition satisfactory for two years; then

* In another case of profuse hæmaturia, also diagnosed and localized with the cystoscope as being of renal origin, Fenwick extirpated the kidney two months and a half after the onset of the symptoms. On making a section of the gland, he discovered "a small monkey-nut-sized growth fungating into the pelvis. This was proved to be the apex of a carcinomatous degeneration which occupied the middle of the anterior half of the kidney. It did not approach the surface, and was quite unfeelable and unrecognizable by means of the finger while the organ was *in situ*" (International Med. Annual, 1892, pages 118 and 119).

chills, fever, unbearable vesical irritability. Marked ureteritis. Cystoscopy: Catarrh. At seat of orifice of left ureter a succulent and curiously folded growth—viz., the swollen and inflamed fold of mucous membrane belonging to and surrounding the ureteral opening; whole mass resembling a large lampshade. Short jets of fluid, mixed with smaller and larger yellow flakes and shreds, come from a somewhat retracted spot, a little to the left from the top of the mass. A few minutes later a long thread of thick, yellow pus was slowly making its way out of the same opening into the bladder. Orifice of right ureter rather rounded; pumps frequently, but comparatively regularly. Urine clear. Efflux timed: Right, every twelve to twenty-five seconds; left, every six to eight minutes; the period of the emission of the jet on the right somewhat longer than on the left side. Conclusion: Left kidney nearly useless; right, seemingly healthy, doing from twelve to sixteen times as much work as the left. Specimen obtained by successful nephrectomy finally corroborated the cystoscopic diagnosis.—(AUTHOR.)

CASE III.—Lady, forty-eight; urinary trouble for fourteen years. Lately urine very offensive, murky, two thirds of volume sediment. Cystoscopy, December 18, 1890: Mucous membrane hyperæmic, and around left ureteral orifice papillomatous. Out of the latter a very long, worm-like, under the electric illumination snow-white, shining thread of thick pus of the size of a thin pencil very languidly makes its ways at short intervals. No jet whatever. The long strings settle and curl in the bladder fundus—a very characteristic picture. Right ureteral orifice occupied by a round red growth of the size of a cherry. On putting prism quite close to it, it appeared transparent. Out of its left (median) side jets of seemingly clear urine thrown at short intervals. Prolapse of ureter. Cystoscopic diagnosis: "Left suppurating kidney. Its secreting tissue entirely gone. Right kidney already does double duty for its destroyed fellow. Some irritation in the pelvis of the right kidney." Nephrectomy. Kidney greatly enlarged, sclerosed, with many cavities; in them a large ramified stone. Uninterrupted recovery. On thirty-ninth day intense right renal colic and abundant hæmaturia. After five days of serious—nearly hopeless—illness, a stone was passed, an excellent "*demonstratio ad oculos*" of the pathognomonic correctness of prolapse of ureter. Rapid, perfect recovery.—(AUTHOR.)

CASE IV.—Gentleman, fifty-three; suprapubic lithotomy in 1888. Three years later symptoms of left renal calculus with irritable bladder. Cystoscopy, April, 1891: Bladder comparatively healthy. Prostate large, easily bleeding. Right ureter pumping at regular though rather short intervals; ejects clear fluid. Whirlings propelled from left ureteral opening by far less frequent; last nearly as long as three of the opposite side combined. Phenomenon can be noticed with so much greater precision, as urine of corresponding kidney is slightly turbid. No renal hæmaturia present. Diagnosis (also with reference to history, general condition, etc.): "Stone in pelvis of left kidney large enough to partially block the upper ureteral opening." Second cystoscopic examination fully corroborated result of first. Explanation: Urine has to gather in greater quantity, and has to distend pelvis of left kidney more than ordinarily before finding, or rather making, its outlet on one or more spots alongside the necessarily irregular surface of a probable stone. Nephrolithotomy, May 5, 1891. Large stone two inches long, presenting perfect cast of the enlarged pelvis of kidney and upper part of ureter. Lower pole flattened in a shape not unlike the mouth-piece of a flute. Suture of pelvis. Primary union. Rapid

recovery. Sixteen days later, at home, very intense renal colic on opposite (right) side, lasting six hours. To-day free from pain. Still under observation. —(AUTHOR.)

CASE V.—Man, sixty-eight; bladder trouble for ten years. Intermittent retention and slight hæmaturia; depends upon catheter; marked vesical catarrh; irritability; pain in left lumbar region.

Irrigation of bladder for one week. Then cystoscopy: Trabecular bladder. Mucous membrane pale. Prostate enlarged in entire mass. Right ureter pumps at regular intervals. Jets at mouth of left not marked. There is a *continuous exit* of whirling, slightly turbid water, which did not stop during an at least five minutes' examination. Mouth of ureter always in same position; does not protrude nor recede; widely gaping. Picture resembles exactly that of a slightly smoking chimney. Eyes being tired, light was turned off and examination stopped. Phenomenon then watched again; same result in most elegant precision. Diagnosis: Hypertrophy of prostate, chronic catarrh, dilatation of left ureter with loss of muscular power. Urine simply runs down into the bladder as soon as formed, mainly on account of its gravity. Pyelitis sinistra.—(AUTHOR.)

CASE VI.—Male, thirty-nine. Sent for diagnosis by an eminent specialist. Fifteen years ago, gonorrhœal discharge for four months; bilateral epididymitis. Seven years later, chancre. Five years ago, again urethral discharge. Two weeks later suddenly acute right pyelitis with grave bladder symptoms. In eight ounces of urine at least six ounces of thick, gelatinous pus. For three months seriously sick. Since then condition bearable, sometimes satisfactory; intervening times of general *malaise*. Irritable bladder. Slight hæmaturia. January, 1891, chill; recurrence of serious character. External and internal urethrotomy. Lately, sound 32 French passes. Questions to be answered: Is neck of bladder affected? Are both kidneys diseased, or only one; if so, which? General examination: No lumbar tumor; prostate slightly enlarged. Urine: Chemical analysis negative; microscopical: a few pus-cells; micro-organisms of various kinds; no tubercle bacilli. Scelices and hooks of the parasite "*tænia echinococcus*" (hydatid).^{*} Cystoscopy: Bladder healthy. Fundus hyperæmic. Prostate irregular. Right ureteral orifice oval, gaping, about three times as large as on the opposite side, not on top of cone, but drawn backward from the fold of mucous membrane. Jets clear, now and then with a few long white shreds.[†] Left ureteral opening and kidney urine normal. Diagnosis: Echinococcus (hydatid) of right kidney, probably multilocular cyst or cysts, communicating with pelvis of right kidney. Right chronic ureteritis. Indication for radical cure: Extirpation of right kidney. Whether this operation has been performed meanwhile I am unable to tell.

^{*} Patient, when asked later, stated that as long as he can remember he had dogs around him. He often petted and "kissed" them.

[†] I want to state here that, even with the able help of the irrigating cystoscope, it is extremely difficult, if not in many cases impossible, to make out a urine which is only very slightly turbid, or which is clear and contains long, tiny shreds of tissue. Generally a certain amount of turbidity is required before it becomes visually apparent and perceptible. Bimannual, sharp palpation of the suspected diseased organ during examination will frequently help in making the cystoscopic diagnosis of renal pyuria.

NOTE.—For making a urethro-cystoscopic report, I should venture to propose the following scheme for the cystoscopist:

I. Urethra: 1, Meatus; 2, caliber; 3, discharge from anterior urethra; 4, discharge from posterior urethra; 5, urethroscopic result.

II. Prostate gland: 1, Amount of residual urine; 2, rectal palpation; 3, cystoscopic appearance (also of fold of mucous membrane around upper circumference of internal urethral orifice, so-called "inner fold").

III. Bladder: 1, Urinary analysis; *a*, chemical; *b*, microscopical; 2, cystoscopic picture; *a*, vertex, posterior and lateral walls; *b*, fundus; *c*, right ureteral opening and cone; *d*, left ureteral opening and cone.

IV. Ureter: Rectal or vaginal palpation; *a*, right; *b*, left.

V. Kidney: 1, Bimanual palpation, etc.; 2, jets of urine; *a*, as seen with the cystoscope; color; transparency; frequency; other characteristics; *b*, as gathered separately through catheterization of the ureters (dream of the future).

VI. Remarks.

VII. Cystoscopic diagnosis.

As is seen, the cystoscope has literally carried a bright light into this hitherto dark field of urinary surgery. It has elevated the diagnosis of an obscure urinary disease from mere guesswork on a scientific base. It has thus greatly widened and strengthened our means for making the indication and prognosis of nephrectomy. The time has more or less passed where the surgeon, after a nephrectomy, must anxiously wait to know whether the other kidney would now kindly do the work for its removed fellow, or whether this organ of last resort were also diseased. To-day these vital questions can nearly always be settled *before* the operation, by cystoscopy. Its results are reliable; they may, will, and must guide the surgeon. If the latter has previously ascertained that the opposite kidney is working well and that its urine is apparently healthy, and if, then, immediately after nephrectomy, the urine voided through the urethra suddenly appears very turbid, this will be proof to him that the second kidney is also diseased.* He may conclude that the sudden hyperæmia of the remaining kidney, setting in after the removal of the other (Author: Nephrotomy for the relief of sudden total suppression of urine occurring some time after nephrectomy. *Annals of Surgery*, April, 1892), has aggravated the slumbering trouble and made it thus apparent. Prognosis then doubtful. Still, it is to be expected that the sudden increase of the disease in the remaining kidney, especially if it be of a surgical character, will gradually wear off with the re-establishment of a more normal circulation. If, however, the urine, which in the cystoscopic examination before the operation had clearly been seen descending from the opposite kidney, is suddenly suppressed after nephrectomy for longer than twenty-four to forty-eight hours, the surgeon has still resources by which he may try to save the patient's greatly endangered life. If the anuria is not due to nervous reflex, it may be caused

* Tubercular urinary disease is excluded from these considerations.

by a mechanical occlusion of the pelvis or ureter of the remaining kidney. And this mechanical occlusion may still be removable by a promptly performed nephrotomy on the second kidney.

These cystoscopic facts bearing on the condition of the kidneys will also tend to make superfluous, in the majority of cases at least, a suprapubic or perineal incision for diagnostic purposes, as well as a nephrotomy performed for determining the action of the other (not diseased) kidney, as also determined opening of the peritoneal cavity during nephrectomy, to prove, by palpation, the presence of the opposite kidney.

Of course, not all exploratory operations will thus become obsolete. It is obvious that there will still be a number of cases where obstacles will render the ocular inspection of the bladder and of the descending jets of urine impracticable; where an insufficient capacity of the bladder, or an abundant vesical hæmaturia, will make the electric illumination of the bladder useless. In such cases suprapubic cystotomy for catheterizing the ureters in renal disease (and even Sir Henry Thompson's digital exploration of the bladder for diagnosing vesical troubles) may still be indicated. But these cases will henceforth be exceptions, and their number will continue to lessen with every advance in endoscopic diagnosis, with every increase in the dexterity and experience of the cystoscopist, and with the additional construction of a really useful cystoscope for catheterism of the ureters.

Catheterization of the Ureters.—The careful observation and analyzation of the "character" of the jets of urine with the cystoscope at the mouth of the ureters in the bladder is already a great means to diagnose disease of the kidney. In many cases this "visual analysis" of the fresh "kidney-urine" has proved to be sufficient for the establishment of a strict diagnosis and prognosis. Still, it would be very desirable in every case, and really necessary in many, to be in the possession of comparatively easy means by which the urine of each kidney may be gathered separately for careful microscopical and chemical analysis.

Attempts at solving this problem are manifold.* Yet I am fully

* Tuehmann, Ueber ein neues Mittel zur Diagnose der Blasen u. Nierenkrankheiten, Wiener med. Wochenschr., 1874, Nos. 31 and 32. Ueber den kuenstlichen Verschluss u. ueber die Sondirung des Harnleiters, Deutsche Zeitschr. f. Chirurgie, Bd. vi, p. 560. O. Silbermann, Ueber eine neue Methode, der temporaeren Harnleiterverschliessung u. ihre diagnostische Verwertung für die Krankheiten des uropoëtischen Systems, Berl. klin. Wochenschr., 1883, No. 34. In the female, our non-operative diagnostic means in this respect have been more ample, however difficult to practice, for a number of years. Cf. G. Simon, Ueber die Methoden, die weibliche Urinblase zugaengig zu machen u. ueber die Sondirung der Harnleiter beim Weibe. Volkmann's klin. Vortraege, No. 88. Lewers, Lancet, 1886, November 13th. K. Pawlik, Ueber Harnleitersondirung beim Weibe und ihre praktische Verwendung, Wiener med. Presse, 1886, Nos. 44-51.

convinced that the cystoscope is the instrument which is going to solve this practical problem. We are still in need of a really useful cystoscope for catheterization of the ureters. The method of introducing a thin bougie, catheter, or sound alongside the cystoscope into the bladder, and then trying to make its tip enter the mouth of the ureter, is a bad one. The secondary instrument is greatly hampered in its motions by the presence of the cystoscope in the same channel. Moreover, it can only be practiced in the female, and even there the manipulation is very difficult. The catheter for the kidneys must be passed through a separate channel of the cystoscope proper. But it can not fit in the channel as snugly as a mandrel does. It has to remain freely movable. Consequently there must be leakage, as the intravesical pressure is greater than the atmospheric. The fluid in the bladder is therefore slowly ebbing away, the clear appearance of the cystoscopic picture changed, the position of the ureters annoyingly influenced. The instrument must therefore enable us to easily replace the fluid which is running away (as this is the case in the Paris instrument), and the thin catheter must be engaged in the mouth of and pushed forward into the ureter as quickly as possible. For this latter reason it may be advisable to first find and localize the mouth of the ureters with cystoscope No. 1 before attempting catheterization. The pictures as seen through the latter are more familiar to the eye of the cystoscopist, as the prism and lamp are on the concave side.

The only partially useful instrument for the purpose under consideration has so far been that manufactured at Paris. Its advantages and drawbacks have been described elsewhere.

It is to be regretted that Nitze's inventive faculty already began to apply his cystoscope for the *treatment* of bladder diseases before he had entirely exhausted the diagnostic side of its usefulness. All cystoscopists are anxiously waiting for a cystoscope for catheterizing the ureters "according to the Berlin pattern." Nitze should give it to us. Its "practical" construction will really complete the diagnostic capabilities of his instrument from a mechanical standpoint.*

If Nitze's irrigating cystoscope were built according to the pattern No. 2, and if the tube which at present gives exit to the water could be

* One might say, Why is the construction of such an instrument not tried in this country? Why is it necessary for us to wait until Nitze bestows upon us this new, greatly needed gift? The answer is simple. The manufacture of the cystoscope would require a factory which is specially fitted up for this purpose. A trial to make the cystoscopes here would consume an immense amount of money, and would probably at the end be a failure (as partially demonstrated by the trial of Messrs. F. A. Reichart & Co., of New York City, Author, *Progress of Cystoscopy*, *loc. cit.*). And the finished instrument, even if useful, would be by far more expensive than that made abroad.

arranged so as to run at the lower aspect of the shaft and to end at the convexity of the junction of beak and shaft (as in Brenner's and Boisseau's modification), the problem would, I believe, be best solved. The amount of water lost by the continuous leakage could then be easily replaced through the afferent tube. Perhaps such an arrangement would make the now rounded shape slightly oval, but that would be immaterial.*

The catheterism of the ureters with the help of special cystoscopic instruments will, I trust, soon be an extremely important and never-to-be-omitted factor in cystoscopy for renal disease. Its results will greatly reflect upon and vastly increase the correctness and exhaustiveness of such a cystoscopic diagnosis. The catheterism of the ureters in this way will easily, simply, and happily solve the great problem—the bloodless, separate collection and analyzation of the secretion of each kidney.

* Brenner, Poirier, and others have catheterized the ureters, in a few instances, with the help of a channeled cystoscope. My own trials in this respect have so far only been made in the female with Brenner's and Boisseau's modifications of the Berlin pattern. The former instrument is badly fitted for the purpose under consideration. Its curve at junction and shaft is too slight. I succeeded in three patients in engaging the thin catheter in the mouth of the ureters, and in passing it slightly forward.

EXPLANATION OF FIGURES ON PLATE IV.

Fig. 28, tubercular cystitis; primary stage. (Cystoscope I.) Numerous minute ecchymoses, surrounded by a hyperæmic spot; many ramified vessels.

Fig. 29, partial hypertrophy of the prostate. (Cystoscope II.) Enlarged median lobe, projecting into the bladder.

Fig. 30, marked bilateral hypertrophy of the prostate; trabecular bladder. (Cystoscope II.)

Fig. 32, trabecular bladder; diverticulum of the lateral wall. (Cystoscope I.)

Fig. 33, encysted multiple stones—four only are shown. (Cystoscope I.)

Fig. 36, pin fixed in the anterior wall of the bladder, near its vertex; shadow on opposite wall. (Cystoscope I.)

Fig. 37, silk ligature adherent to the wall of the bladder; it projects from a red papilla (granulation tissue). (Cystoscope I.)

Fig. 38, two fragments of stone which remained in the bladder after lithotomy; in the larger one the nucleus of uric acid is seen. (Cystoscope I.)

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THE CYSTITES.

By SAMUEL ALEXANDER, M. D.

DURING the first half of this century the nature of inflammation of the bladder was imperfectly understood. Civiale was the first to call attention to the constant discharge of pus in the urine of cystitis as the principal clinical distinction between inflammation and certain non-inflammatory conditions of the urinary tract that formerly had been regarded as forms of cystitis. Until quite recently, however, the study of inflammation of the bladder was confined almost exclusively to its clinical aspect. The study of the pathology and pathological anatomy of its lesions was neglected. Much of the vagueness and mystery that formerly existed in regard to the nature of inflammation has been cleared away by the advent of modern pathological doctrines. Recent investigation in regard to the nature and causes of urinary infection justify us in regarding all suppurative lesions of the bladder—i. e., the cystites—as forms of local microbic infection.

Definition.—The term *cystitis* has a precise significance in modern pathology. It indicates local infection or inflammation of the urinary bladder. The suppurative lesions of the bladder will, in this article, be described collectively as *the cystites*.

Classification.—On account of the number and variety of the lesions of cystitis, the clinical aspect of the disease is subject to great variations. A satisfactory classification is impossible at the present time, owing to an imperfect knowledge of the pathological anatomy of the lesions, and of the relation of the different lesions to the clinical aspect of the disease.

As a result of the numerous classifications that have been made, a great number of terms have been introduced into modern surgical literature, for the purpose of indicating different varieties and sub-varieties of inflammation of the bladder.

Definition of Terms.—The terms *acute* and *chronic* are used by many writers as if they described types of cystitis. These terms have a relative not a positive meaning, and should be used to indicate either the duration or the intensity of an inflammation. They refer more to symptoms than to the lesions. There are no special lesions characteristic of

an acute or of a chronic inflammation, and the line of demarcation between them is not sharply defined, as is shown by the use of the term *subacute*.

An acute cystitis is one in which pain, frequent micturition, etc., are prominent symptoms, and which is of comparatively recent occurrence. A chronic cystitis may develop acute symptoms, owing to increased congestion.

The terms *purulent cystitis* and *hæmorrhagic cystitis* should be given up. All the cystites are characterized by pus in the urine, the character or the amount of the pus taken alone is not characteristic of any type of the disease. A similar objection may be made to the term *hæmorrhagic cystitis*. The term *painful cystitis* has been used by Guyon to describe a clinical type of inflammation in which the symptom of pain is a marked and persistent feature; there are no special lesions, however, which characterize this form of the disease.

The distinction between cystitis of the neck of the bladder and cystitis of the body of the bladder has no pathological or clinical significance, and should be given up.

The suggestion has been made recently by Denys to classify the different varieties of cystitis upon the basis of the bacteriological character of the urine. Such a classification has very little practical value, since the morphological character of many of the microbes is not distinctive. A careful study of the different lesions of inflammation of the bladder, and of the clinical aspect of each, is the only scientifically accurate and satisfactory basis upon which to classify the different varieties of cystitis; but as a classification upon this basis is at the present time impossible, some other, for the time being, must be adopted.

There are certain diseases in which cystitis, although not an essential feature in their clinical history, plays frequently an important part. These diseases determine and modify to a great degree the course and the character of the vesical inflammation, and may be regarded as predisposing causes. We may recognize with propriety and practical advantage the following clinical types of cystitis: 1, The cystites of gonorrhœa; 2, The cystites of tubercle; 3, The cystites of stricture; 4, The cystites of calculus; 5, The cystites of tumor; and, 6, The cystites of prostatics.

It must be understood that these terms do not indicate that special inflammatory lesions are peculiar to any of these varieties of cystitis. In addition to the varieties which I have mentioned, there are two sub-varieties of cystitis which merit special mention, since they are characterized by well-marked lesions and a more or less well-defined clinical course. I refer to the pseudo-membranous and the membranous cystites, and to "nodular cystitis."

Sensibility of the Bladder.—The normal bladder has very little sensibility to contact. It is wholly insensitive to the contact of un-irritating fluids at a temperature of about 100° Fahr. The urine as it enters the bladder produces no sensation, and the same is true of fluids injected into the bladder through a catheter. The healthy bladder likewise is almost entirely insensitive to the contact of solids or semi-solids. A soft catheter or bougie produces a distinct sensation while passing through the urethra, but its contact with the bladder causes no pain and very little if any sensation, unless the contact be repeated and violent. There is a slight difference between the contact sensibility of the mucous membrane about the internal urethral orifice and that of the body of the bladder, the former being a little more sensitive. The sensibility of the normal bladder is a sensibility to tension. *The normal capacity of a healthy bladder is the amount of urine which it can contain without producing the desire to micturate.* When the normal capacity of the bladder is exceeded, the bladder contracts, and this causes the desire to pass water, the intensity of the desire being in proportion to the force of the contraction. Repeated and prolonged or violent contact of solids also may cause a desire to pass water, but contraction is necessary to produce the sensation. The normal bladder is very sensitive to the contact of irritating fluids, and to extreme heat or cold. The intense pain which an irritating injection causes is in fact a vesical colic, and is due to the violent contraction of the bladder. If analyzed, the sensation thus produced will be found to be an intense and prolonged and painful desire to pass water.

The sensibility of the bladder to tension and to contact depends upon the degree of hyperæmia or congestion. A metal or a soft catheter or bougie causes pain when brought into contact with the *inflamed* mucous membrane. Distention of the organ when inflamed causes a violent and painful desire to pass water.

The Physiology of Congestion.—The normal urinary bladder is exceedingly vascular; the blood-vessels which traverse the mucous membrane and submucous connective tissue anastomose with each other, and form a very rich capillary plexus; the superficial vessels of the latter lie directly beneath the epithelium; these vessels have an arborescent arrangement, as seen through the cystoscope. The blood-vessels are larger and more numerous in the neighborhood of the trigone, about the ureteral orifices, and the internal orifice of the urethra, than elsewhere. In the neighborhood of the trigone there is also a very rich plexus of veins, which converge toward the neck of the bladder, and empty into the plexus of Santorini. In the vessels of the normal bladder the amount of blood varies at different times, according to the tension of its walls. When empty, the bladder is comparatively anæmic; the mucous membrane is

of a pale, pinkish color, notwithstanding its great vascularity. As the walls of the bladder distend, the amount of blood in the vessels, especially in the veins, gradually increases; when the capacity of the bladder is exceeded the detrusor muscle contracts, and the blood in the vessels is increased still further. If the bladder is not emptied the contractions increase in violence, and the congestion becomes more and more marked. Under these circumstances the mucous membrane, especially over the trigone and about the urethral orifice, becomes reddened, the superficial vessels are engorged, and small extravasations of blood may occur as the result of this excessive hyperæmia. The superficial capillaries may rupture, and a more or less severe hæmorrhage result.

The principal causes of congestion of the bladder are, distention, increased muscular effort, frequent, repeated, and long-continued or violent contacts of solids, and chemical irritation.

Pathological Anatomy.—The frequency of cystitis, the number and variety of its lesions, and the clinical importance of the disease, are sufficient reasons to demand a most careful and thorough study of the pathological changes which occur in the bladder as the result of local microbic infection. Guyon was not understating our present knowledge when he said that the entire pathological histology of the chronic cystites had yet to be written.

The following is a description of the location and general character of the principal lesions:

Situation of the Lesions.—The prostatic urethra, which is to be regarded pathologically and physiologically as part of the urinary bladder, is involved in all cases of cystitis. The inflammation is more intense in this situation when the disease is due to the extension of a urethritis backward along the mucous membrane. The entire bladder may become inflamed during the course of a cystitis, but the degree of inflammation and the distribution and arrangement of the lesions is not uniform. There are certain situations which are always inflamed in cystitis, and whatever may be the cause or duration of the disease the lesions in these situations are always more prominent than elsewhere. These are, first, the trigone and the mucous membrane about the internal ureteral orifices; second, the region about the internal orifice of the urethra; and, third, the prostatic urethra. The inflammation nearly always begins in the mucous membrane, and thence may extend through the entire thickness of the bladder wall; the mucous membrane, however, is the site of the principal lesions in most cases. The muscular coat is involved to an appreciable extent only after the disease has continued for some time; the serous coat is involved as the result of extension from the muscular coat or from somewhere without the bladder. The intensity of the inflammation varies; it may be *acute*, *subacute*, or *chronic*, depending

upon the degree of congestion. An acute or subacute inflammation may become chronic, and a chronic inflammation may develop acute symptoms. The lesions of cystitis may be transient, or they may result in more or less serious structural changes.

Description of the Lesions.—In describing the pathological anatomy of the lesions the following classification is convenient: 1. The superficial cystites. 2. The interstitial cystites. 3. The productive cystites.

The superficial cystites include those lesions which are situated almost exclusively in the mucous membrane. They are transient, and do not usually cause permanent alteration in structure. The inflammation may be acute or chronic, depending upon the cause and degree of congestion. Almost every cystitis begins as a superficial inflammation.

The lesions of the interstitial cystites involve the mucous membrane, and to a greater or lesser extent the connective tissue and muscle. Inflammation of the serous coat, or pericystitis, may be included under this head. The lesions of interstitial cystitis may or may not result in permanent injury to the bladder.

The productive cystites include the lesions of tubercle, enlargement of solitary lymphatic follicles, diphtheritic membranes, ulcerations, villosities, and fungo-vascular excrecences. These lesions usually are chronic as to the time of their appearance, but acute symptoms often develop. They are associated either with the superficial or interstitial lesions.

This classification is purely artificial. There are no sharply defined lines of demarcation between the superficial and interstitial lesions. The inflammation may continue to be superficial throughout its entire course, or it may become interstitial or productive.

The Superficial Cystites.—These lesions vary according to the intensity and duration of the disease. In recent cases of acute cystitis all the vessels of the bladder, but especially those which are superficial, are intensely congested. Seen through the cystoscope, they appear as interlacing lines of a bright-red color, the arborescent arrangement being marked. Small extravasations of blood appear upon the surface of the mucous membrane as dark-red points. The mucous membrane itself is reddened, especially along the course of the capillaries. The vascular injection and reddening, which are not uniform, but occur in patches, are most marked in the region of the trigone. The mucous membrane is swollen and oedematous. Early in the disease the urine is acid in reaction, but decomposes rapidly outside the bladder. During this stage the urine does not contain albumin unless blood is present, but pus and epithelial cells from the surface of the membrane are present in a greater or a lesser number, according to the duration of the disease. The epithelial cells are more or less altered, being granular, with two or more nuclei. Blood is present when the cystitis is very acute, there being more blood in the urine passed at the

end of micturition. Small granulations or exulcerations may appear on the surface of the mucous membrane. Patches of membrane resembling that of diphtheria may be present when the inflammation is very intense. Small vesicles, resembling those of sudamina, may appear in certain cases. In chronic cases the mucous membrane is softened and thickened. Its surface is covered when there is ammonuria, with a thick, grayish-white or yellowish-white gelatinous material, consisting of altered pus and urine. The color of the mucous membrane may be nearly normal, or it may be yellowish or grayish. The superficial vessels are more or less prominent, depending upon the intensity of the inflammation. The surface of the mucous membrane is lusterless, and here and there irregular reddish areas may be seen from which the epithelium has been stripped.

When the inflammation has existed for some time, the folds of the membrane are elevated and reddened, especially along their tops. When there are congenital diverticula or pouches, these contain a mixture of pus and urine which may be squeezed out. The epithelium is softened and is thrown off in shreds, leaving bare patches of the mucous membrane proper. From the edges and surfaces of these patches shreds may float out into the urine, resembling small, dirty villi. The urine is neutral or alkaline, usually of a yellowish or grayish color, and deposits a heavy sediment of pus, or a viscid, mucoid substance consisting of altered pus and epithelium, triple phosphate crystals and bacteria. The epithelium is from the lower layers of the mucous membrane. Sometimes upon the denuded areas of the membrane the urinary salts are deposited. These patches are then of a dirty-white or brownish color, and may be mistaken for calculi. The urine may contain albumin, but it is usually absent.

The Interstitial Cystitis.—The appearances of the mucous membrane do not differ from those described above. When the inflammation extends into the muscular coat, it usually attacks the interstitial connective tissue rather than the muscular trabeculæ; on this account the latter become loosened and undermined. When the mucous membrane is destroyed at any place, small shreds of muscular tissue are sometimes cast off into the urine, or they may appear as floating shreds attached to the bladder wall. The muscular trabeculæ are swollen, and a roughened appearance is given to the surface of the mucous membrane. The trabeculæ themselves may be involved and become destroyed by the suppuration. The whole bladder wall may be converted into a mass of suppurating tissue. Small abscesses may form in the substance of the mucous membrane, or in the submucous tissue, or in the muscle itself. The openings to these abscesses are usually small. Abscesses may open into the normal diverticula, when these exist, or upon the surface of the mucous membrane. Inflammation may involve the entire thickness of the bladder wall and result in a pericystitis. This, however, is rare, and when it

does occur the latter is usually a localized inflammation. The urine is of a dirty yellowish color, usually ammoniacal and very fetid, and contains an enormous number of micro-organisms; it deposits a thick material, consisting of altered pus and epithelium. This is mucilaginous in character, very thick, and adheres to the bottom of the vessel and to the walls of the bladder. As the process of repair begins, new connective tissue forms between the muscular trabeculæ; and if the suppuration has extended into the substance of the muscular trabeculæ themselves, the latter are more or less destroyed. The newly formed connective tissue contracts; the *anatomical* capacity of the bladder is diminished; the elasticity of its walls is destroyed. This is the condition known as contracture of the bladder, and is the only one in which the anatomical capacity of the bladder is lessened.

The Productive Cystites.—For a description of these lesions the reader is referred to special works upon pathological anatomy, since a full description can not be given satisfactorily in a clinical article.

Pathology and Etiology.—The study of experimental pathology and bacteriology has cleared away much of the vagueness and obscurity that formerly existed in regard to the nature of inflammation. Recent investigation by various observers has established the principal facts upon which the modern doctrines of local infection are based, and the microbial origin of suppurative lesions can not any longer be regarded as a mere theory, but must be accepted as an established fact.

General Doctrines as to the Nature of Suppurative Lesions:

1. All suppurative lesions are due to local microbial infection.
2. The microbes having pyogenic powers are numerous and varied.

They may be divided into two classes: (*a*) Those microbes which always produce pus when they exert any pathogenic action. This class includes the staphylococcus pyogenes aureus, albus, and citreus, and the streptococcus pyogenes; and (*b*) those microbes which exert a pyogenic action only under special conditions. These may produce other pathogenic effects, under different conditions. It is certain that many of the microbes having pathogenic power may become pyogenic under favoring conditions.

3. The normal tissues in health are able to resist and to dispose of most pyogenic microbes.

4. The power and action of pyogenic microbes are modified—that is to say, increased or lessened by a great number and variety of conditions. Local infection can occur only when the soil is favorable to the growth and development of the microbe; the simple introduction of a pyogenic germ, the tissues being normal, does not cause suppuration.

The following are the principal factors which modify the action of pyogenic microbes:

A. *Local*: The anatomical and physiological condition of the tissues at the time of infection, especially as to (1) the vigor of the epithelium and its power to resist the poison; (2) as to the normal and regular performance of function; (3) as to the condition of the local circulation; and (4) as to the character of the secretions and their antiseptic properties; and—

B. *General*: The condition of the general constitution, especially as this affects the antiseptic power of the blood plasma.

C. In addition to the above factors which favor infection, there are the following which relate especially to the agent of infection: 1. The species of microbe, and the number introduced at the time of infection. 2. The vigor of the microbe, and its power to produce poison. This latter is modified, to a great extent, by the source and previous environment of the germ.

Conditions necessary to cause Local Infection.—In every local infection three factors are necessary: 1. The presence of microbes having active pyogenic powers. 2. A medium favorable for their development. 3. The power of the tissues must be weakened.

Pathology of Local Infection of the Bladder.—It has been known for a long time that the normal urine contained in the bladder of a person in perfect health is an aseptic fluid. Cultures of such urine remain sterile. This fact, discovered in 1858-'59 by Pasteur, has been repeatedly confirmed since then by numerous observers. On the other hand, we know that the purulent urine in an inflamed bladder always contains numerous micro-organisms. A simple microscopical examination of the urine in a case of cystitis shows, in addition to the pus-corpuscles and other inflammatory products, a variety of microbes, usually in great numbers.

The entire absence of germs from the normal urine, and their constant presence in the purulent urine of cystitis, naturally raises the question as to the relation between these microbes and the occurrence of inflammation of the bladder. According to the general doctrines respecting the nature of suppurative lesions, as stated above, *the cystites* must be regarded as forms of local microbial infection.

In considering the pathology and etiology of cystitis upon the basis of these doctrines, the following questions are presented: 1. What pathogenic microbes are found habitually in the purulent urine of cystitis, and which of these microbes have pyogenic power in the bladder? 2. What is the action of these microbes in causing cystitis? 3. What is the origin of these microbes, and how do they invade the bladder? 4. What are the conditions which favor and what those which retard infection?

The study of microbes found in the urinary tract was begun by Pasteur. His discovery in 1859 of the *micrococcus ureæ*, and the investigations subsequently made by Van Tieghem as to the power of this microbe

to cause decomposition of urea, attracted widespread attention to the study of the pathogenic microbes in the urinary apparatus.

For many years after the publication of Pasteur's discoveries, however, the investigations of nearly all observers were confined almost exclusively to the ammoniogenous action of the microbes found in the urine. But it has been shown recently, both by experiment and clinically, that nearly all the microbes found in the urine have this power to a greater or less degree, but that their pyogenic action in the urinary tract does not depend upon this.

From the discovery of the *micrococcus ureæ* in 1859 to the present time, no less than thirty species of micro-organisms have been found in pathological urine, and have been described by various observers. Many of these have no known pathogenic power; some have been found only in exceptional cases. It is not necessary, for the purposes of a clinical article, to give a description of all these microbes. I shall mention only those which have been found by different observers in the urine of cystitis, and which are known to have distinct and definite pyogenic power in the urinary tract.

Microbes that have a Pyogenic Action in the Urinary Tract:

1. *Micrococci*.—The micrococci habitually present in suppuration, viz., the *staphylococcus pyogenes albus*, *aureus*, *citreus*, and the *streptococcus pyogene*. The action of these germs is general, and it is not surprising, therefore, that they should be found in purulent urine.

2. *Bacilli*.—Two species of bacilli, viz., *urobacillus liquefacius septicus* and a bacillus, which since its discovery by Bouchard in 1879 has been described by various names, and recently has been identified with the *bacillus coli communis*.

Of these microbes, the bacillus coli communis is by far the most common, and next in frequency is the staphylococcus pyogenes aureus. The presence of the former in the urine of cystitis is almost constant. To give an idea of its frequency, I append the following table taken from Guyon's report, showing the result of various observations made in respect to this point:

Albarran and Halle found it in 47 cases of cystitis, out of 50 examined. In 30 cases, studied by cultures, it was found 15 times alone, and 15 times it was associated with other microbes. Albarran found it in 23 cases out of 25; in 16 of the cases it was alone. Morelle found it in 13 cases out of 15; in 6 it was alone. Verogius found it in 12 cases out of 17; in 11 it was alone. Denys found it in 17 cases out of 23; in 15 it was alone.

The Gonococcus and the Tubercle Bacillus.—There are two species of microbes found in pathological urine of cystitis in addition to those mentioned above, which I have omitted purposely from the list. These are

the gonococcus of Neisser and the tubercle bacillus of Koch. Although these microbes have undoubted pathogenic powers in the urinary tract, they can not be regarded as direct causes of cystitis. The gonococcus has unquestionably very active pyogenic powers in the urethra; alone, or associated with other microbes, it causes suppuration in this situation, but it is very doubtful whether the gonococcus has the power to cause any of the complications of gonorrhœa, such as cystitis, epididymitis, or pyelitis. Cystitis has never been produced experimentally by injecting cultures of the gonococcus into the bladder. In the so-called gonorrhœal cystitis, the urine taken directly from the bladder, without any chance of contamination from the urethra, contains very few gonococci. Other microbes which are known to be the cause of other varieties of cystitis, are habitually found in the urine of so-called gonorrhœal cystitis. The rapid manner in which gonorrhœal cystitis yields to treatment is in marked contrast to that of gonorrhœal urethritis. Gonorrhœal cystitis, so called, should be regarded, therefore, as either a mixed infection, or as a simple infection in which the gonococcus takes no part.

The local action of the tubercle bacillus upon the bladder is unique, and it requires a separate consideration. It is claimed that the lesions in the bladder due to the tubercle bacillus when acting alone are not themselves suppurative; these lesions precede the cystitis, and a second infection by other microbes than that of Koch must occur before pus appears in the urine. The cystites of tubercle are the result, first, of infection by the tubercle bacillus, and subsequently by other of the microbes that have pyogenic power in the bladder. It is said that pure cultures of the tubercle bacillus do not cause cystitis experimentally.

Simple and Mixed Infection.—The microbes found in the urine of cystitis are extremely varied. In some cases a single species is found, in others several species may be associated together. In the former case, a cystitis is spoken of as a simple infection; in the latter, as a mixed infection.

That the micro-organisms which I have mentioned as being habitually found in the urine of cystitis are the essential cause of inflammation of the bladder there is abundant proof. It has been shown by repeated experiments that pure cultures of these microbes injected into the bladders of animals after temporary ligation of the urethra, is always followed by cystitis, and that injection of these cultures into the cellular tissues always produces suppuration.

Action of Pyogenic Microbes in the Bladder.—There are two theories which have been advanced to explain the action of micro-organisms in producing cystitis, viz.: 1. That the inflammation is due primarily to the action of the microbes in producing ammoniacal decomposition of urine, the carbonate of ammonia resulting from this fermentation acting directly

as an irritant upon the tissue. 2. That the microbes or their ptomaines act upon the tissues.

The latter theory is true. For practical purposes of treatment it makes little difference whether the germs act directly upon the tissues, or whether their ptomaines are the essential poison. That the germ must have the power to decompose urea in order to cause cystitis, is certainly not true.

While ammoniacal decomposition of urea increases the intensity of an existing inflammation, it is never the cause of cystitis. It has been conclusively shown, by Guiard and Guyon, that ammoniacal fermentation in the bladder occurs as the result of the cystitis, and that unless there is cystitis, ammoniacal decomposition in the bladder does not occur. This question will be discussed more at length in considering ammoniacal fermentation as a symptom of cystitis.

Modes of Infection.—*A priori*, it is evident that the bladder may become infected from two sources—first, through the urethra, and, secondly, through the general circulation, the germs gaining entrance by way of the kidneys and ureters. The former is *direct* infection, the latter is *indirect* infection. Direct infection through the urethra is the rule; indirect infection through the circulation is rarely observed clinically in man.

Indirect Infection.—That indirect infection may occur, has been experimentally demonstrated, but it has not yet been shown that the bladder in man can be infected indirectly without disease of the kidneys. It is by indirect infection that certain cases of cystitis which occur during the progress, or as sequelæ, of general infectious diseases, may be explained. These cases, however, are rare, and before regarding a cystitis as the result of indirect infection we should exclude all forms of direct infection through the urethra.

Direct Infection.—Infection through the urethra may be of two kinds—first, *spontaneous* infection, and, secondly, *provoked* infection. Spontaneous infection occurs when the microbes invade the bladder without mechanical assistance. Provoked infection occurs when microbes are introduced into the bladder mechanically, as upon catheters, or by injection.

Spontaneous Infection.—Spontaneous infection of a healthy and normal bladder occurs clinically only when the urethra is diseased, as in gonorrhœa. On the contrary, spontaneous infection of the bladder is impossible in man when the urethra is healthy and normal. The length of the urethra, and the barrier which the sphincter-urethræ et vesicæ muscles offer, protect the bladder from microbic invasion so long as the urethra is healthy. Spontaneous infection of the female bladder, however, may occur even when the urethra is healthy. Spontaneous infection may occur by the

direct extension of an inflammation along the mucous membrane of the urethra, or microbes may invade the bladder as the result of an ascending infection. When the urethra does not empty itself entirely, the urine retained furnishes the necessary medium for the transmission of microbes into the bladder; and the presence of blood in the urethra after operations, or of pus, may serve the same purpose. In like manner, in cases of retention of urine after the power of the sphincter vesicæ has become weakened the urine escapes, the constant flow of urine (overflow) from the distended bladder furnishes a column of fluid in the urethra, a condition particularly favorable to infection.

Provoked Infection.—Provoked infection through the urethra is much more common clinically than is spontaneous infection. It is most often the result of surgical interference, and usually follows the improper use of instruments, or the use of instruments without aseptic precautions.

Microbes may be carried into the bladder from without by the instruments; but as infection occurs sometimes after the introduction of instruments which have been thoroughly sterilized, it can not be doubted that in such cases the microbes causing the infection existed previously in the urethra, and were conveyed into the bladder by the introduction of the instrument.

All observers agree that the normal urethra contains microbes of various kinds. Petit and Wassermann failed to find, however, any of the pyogenic microbes in the healthy urethræ which they examined. Rovsing, Lustgarten, and Manneberg, hold the opposite opinion as the result of their respective observations. It is certain that the microbes having pyogenic powers in the bladder may be found in diseased urethræ, or in urethræ which have been diseased, but which apparently are healthy at the time the examination is made. This is in accord with our clinical observations.

Conditions which favor Local Infection of the Bladder.—

The fact that the injection of pyogenic microbes into a healthy bladder does not cause cystitis has been demonstrated repeatedly by experiments upon the lower animals, and it is confirmed by the results of daily clinical observations. To produce local infection of the bladder by the injection of pure cultures of the pyogenic microbes found in the urine, it is necessary to ligate temporarily the urethra, so as to produce retention of the urine and distention of the bladder; or to produce a mechanical or chemical traumatism. The proof that local infection of the normal bladder is impossible by the introduction simply of pathogenic microbes is shown clinically by the repeated introduction of instruments without any aseptic precautions, which so constantly occurs. Thus, the passage of catheters which have not been sterilized, the needless or rough use of urethral instruments, injections, etc., fail to produce cystitis in some cases, not be-

cause pathogenic microbes are not introduced thereby into the bladder, but because the bladder is healthy, and its normal mucous membrane is able to resist the poison of these microbes. The study of microbes by culture is most instructive in this connection, and shows to how great an extent the growth and development of pathogenic germs depend upon the character of the medium in which the culture is made. The conditions which favor local infection of the urinary bladder are (1) congestion, (2) retention of urine, and (3) trauma.

Congestion.—It may be stated, as a general axiom, that congestion always precedes inflammation; local infection without congestion never occurs. I have called attention already to the principal causes of congestion of the bladder, and, therefore, need only mention them here. They are (1) distention, (2) increased or repeated muscular contraction, (3) frequent or violent contact of solids, and (4) chemical irritation. Speaking generally, congestion predisposes to cystitis by lessening the resistance of the tissues, and supplies in them the media for the development of the microbes. A congested bladder is, therefore, always in danger of infection.

Retention of Urine.—Retention of urine may be caused by obstruction in the urethra, which may be due to stricture, or to nervous causes, or to an enlarged prostate; or the retention may be due to a lack of muscular power from overdistention, or from paralysis of the bladder. The retention may be acute and complete, or partial and chronic. Retention of urine predisposes to cystitis by causing distention, and thereby increased muscular effort, resulting in congestion. The urine, although itself an aseptic fluid, soon becomes a favorable medium for the development of microbes, if retained in the bladder when the latter is congested. Acute retention of the urine is much more favorable to local infection of the bladder than chronic or partial retention, because the congestion which it causes is greater.

Trauma.—This includes the repeated or violent contact of solids with the bladder, such as occurs in vesical calculi or are caused by the rough use of instruments. Trauma predisposes to cystitis by causing congestion, and by affording an opportunity for microbes more easily to enter the tissues owing to the destruction of the epithelium, by favoring the growth of microbes in the urine, and by weakening the power of the tissues to resist the poison. Inflammation of the bladder, however, occurring as the result of trauma is not necessarily more intense than when due to other causes. In addition to these local causes there are certain general constitutional conditions which predispose to local vesical infection. These will be mentioned more fully in the next section.

Clinical Causes of Cystitis.—Although the gonococcus acting alone can not be regarded as the essential cause of cystitis, yet gonor-

rhœa is one of the most common of the conditions which predispose to local microbial infection of the bladder. Cystitis may occur as a result of an acute or a chronic gonorrhœa.

Acute Gonorrhœa.—Cystitis rarely occurs as the result of a first gonorrhœa until the disease has reached its height—i. e., about the end of the third or the fourth week. Spontaneous infection of the bladder may then occur where there is a constitutional predisposition to suppuration, by direct continuation of the inflammation along the mucous membrane of the urethra. In an acute gonorrhœa, the infection of the bladder is much more commonly provoked by the improper use of urethral injections, or the improper introduction of surgical instruments without aseptic precautions. When the inflammation has extended into the posterior urethra, sexual excitement or sexual intercourse, or the use of alcoholic stimulants, may provoke a cystitis during the acute stage of a gonorrhœa. The swelling of the mucous membrane of the urethra in acute cystitis obstructs to a certain extent the outflow of urine, causing an increased muscular effort of the bladder to overcome this obstruction and to empty the bladder, and this increased muscular effort, if long continued, results in congestion and favors infection. Or, retention of urine may occur during the course of an acute gonorrhœa, as the result of muscular spasm of the compressor urethræ. The passage of a catheter at such a time for the purpose of relieving the retention, without strict antiseptic precautions, both as regards the instrument and the anterior urethra, is almost certain to be followed by cystitis.

Chronic Gonorrhœa.—Cystitis as the result of a chronic gonorrhœa rarely occurs when the inflammation is in the pendulous urethra only. When the bulbous portion and the posterior urethra are the seat of chronic inflammation, spontaneous infection of the bladder may occur as the result of apparently slight causes. Thus, sexual intercourse or prolonged sexual excitement, or the use of alcoholic stimulants, or even a sudden check of perspiration, or fatigue, may cause infection of the bladder by direct extension of the inflammation from the deep urethra.

The infection is usually provoked by the introduction of instruments, or by the improper use of injections. The microbes may be carried from without into the bladder, or the instrument may carry germs from the urethra. The rough use of an instrument in a chronically inflamed urethra may increase the intensity of the inflammation, which then may extend backward to the bladder.

Stricture.—Stricture is usually put by most writers as among the commoner causes of cystitis. It is of rare occurrence, however, unless there is great obstruction to the outflow of urine, which has existed for a long time. The cystitis of stricture, therefore, occur late in the course of the disease, but rarely as the result of stricture of the pendulous portion of

the urethra. They are most commonly caused by a stricture situated at or near the bulbo-membranous junction. Stricture favors local inflammation of the bladder (1) by causing obstruction to the outflow of urine, and increasing the force of the contractions of the detrusor muscle, thus producing congestion; (2) by causing retention of urine and distention of the bladder; (3) by favoring the growth of microbes in the urethra, just behind the stricture, and by favoring their introduction into the bladder, as the result of surgical treatment. Cystitis is more likely to result from a stricture, when the latter causes retention of urine, especially when the retention is acute, as in cases of traumatic stricture. The sudden obstruction to the outflow of urine produces intense congestion of the bladder, and under these circumstances, if a catheter is introduced without the strictest aseptic precautions, it is almost certain to be followed by cystitis. The dilatation of the urethra which occurs immediately behind a narrow stricture of long standing favors the growth and development of pathogenic microbes. In such a dilatation a little urine always remains behind after each act of micturition; this decomposing, increases the urethral inflammation at that point. In such a dilatation, containing a fluid favorable to the development of microbes, the latter develop slowly or rapidly, and may at any time be carried into the bladder by instruments introduced through the urethra.

Chronic Prostatitis.—Inflammation of the bladder is very common as a result of prostatic hypertrophy. The cystites of prostatics may be divided into two classes, viz.: (1) those in which there is retention of urine, complete or partial, without distention of the bladder; (2) those in which there is partial or complete retention of urine with distention of the bladder. The conditions which favor local infection of the bladder in prostatics are: (1) the congestion due to frequent micturition, and to the increased muscular effort necessary to overcome the obstruction caused by the enlarged prostate; (2) the anatomical state of the bladder due to this increased muscular effort; (3) the age of the patient, the latter condition weakening the power of resistance; (4) retention of urine.

In the second class of cases, namely, those in which the bladder is distended, in addition to the causes just mentioned, the congestion is increased by the distention of the bladder. In both classes of cases the retention of urine supplies a favorable medium for the growth of pathogenic microbes. In cases of partial retention of urine due to prostatic hypertrophy, the microbes are usually introduced into the bladder upon the instruments used for purposes of diagnosis or of treatment without thorough aseptic precautions. Cystitis is much more likely to occur from this cause, however, in cases in which there is acute retention of urine, such as occurs from chilling of the surface of the body, or from sexual excitement, or from alcoholic stimulation, or from errors in diet.

Calculus.—It is an error to suppose that inflammation of the bladder is a common result of vesical calculus because cystitis is found in the majority of cases of stone. Phosphatic or secondary calculi often occur as the result of cystitis associated with partial retention of urine. When the calculus is primary—that is, of renal origin—cystitis is the exception, and not the rule. The contact sensibility of the bladder being slight, a smooth calculus may remain a long time in the bladder without producing any serious results. The constant violence, however, done to the bladder by the repeated contact of a calculus after a time causes congestion, and thus predisposes to cystitis. In cases of vesical calculus the congestion of the bladder is increased by exercise and by jolting, as in riding or driving. In the majority of cases of calculus cystitis the infection of the bladder is provoked by the improper use of unsterilized instruments, employed either for the purpose of exploring the bladder or removing the calculus. It is likely to follow operations where the entire calculus is not removed. The repeated contact with the bladder of the sharp fragments remaining behind increases congestion and favors infection.

Vesical Tumors.—Morbid growths of the bladder favor local infection by causing congestion and by weakening the power of the tissues to resist the action of the microbes. The hæmorrhage, which is so constant a symptom of tumors of the bladder, furnishes a favorable medium for the development and growth of micro-organisms. Cystitis rarely occurs spontaneously in cases of tumor, the infection being usually provoked by the introduction of surgical instruments. Cystitis occurs more often in cases in which hæmaturia is a prominent symptom.

The Action of Cold.—Cold is mentioned as one of the common causes of cystitis. It can not be doubted that the sudden chilling of the surface of the body often determines cystitis when the conditions favorable for infection are present, but the influence of cold alone can not produce a cystitis. When the surface of the body becomes chilled, congestion of the internal organs occurs, and the general vitality and power of resistance of the tissues are diminished. The action of cold in causing cystitis is frequently seen clinically in cases of stricture or prostatic hypertrophy where the conditions favorable for infection have existed for a long time, and where the action of the cold, by increasing the congestion of the bladder and by diminishing the resistance of the tissues, determines the infection.

Sexual Excitement.—Prolonged sexual excitement or sexual intercourse may become a factor in causing cystitis by increasing the local congestion of the bladder, especially in cases in which the posterior urethra is inflamed. In such cases the bladder is involved by the direct extension backward of the inflammation.

Gout and Rheumatism.—Gout and rheumatism are often mentioned by authors as direct causes of cystitis. If they exert any influence, it is simply that of weakening the general resistance of the tissues to infection. There is certainly no separate form of cystitis characteristic of these diseases, and many cystites occurring during an attack of gout or rheumatism are not affected by anti-rheumatic treatment. The irritating effect of very acid urine, and of urine containing crystals, may predispose to cystitis.

Infectious Diseases.—Cystitis occurring during the course or convalescence of certain acute infectious diseases is frequently due to retention of urine, which may occur as the result of all febrile diseases. This retention is of nervous origin, and is due to spasmodic contraction of the compressor urethræ muscle. If not immediately relieved, intense congestion of the bladder is likely to occur, and thus the conditions favorable for local infection are developed.

In addition to these local causes the power of the tissues to resist infection are weakened by the disease, and the action of microbes, introduced as the result of careless catheterism, is favored. The increased quantity of urea is another predisposing factor in these cases.

Paralysis.—In cases of paraplegia, where there is retention of urine, the sensibility of the bladder is lost; and there being no contraction of the detrusor muscle, there is little active congestion. Passive congestion due to tension occurs. The power of the tissues to resist infection is weakened as the result of trophic disturbances resulting from the lack of nervous force. These conditions favor infection, which is provoked usually by catheterism.

Symptomatology.—The clinical aspect of inflammation of the bladder is subject to great variations. The evolution, course, duration, and severity of the symptoms differ in the different types of cystitis, and in different cases of the same type, according to the cause and intensity of the inflammation. There are certain symptoms which, when present, are characteristic of cystitis. There are other symptoms which are not characteristic, individually, of inflammation of the bladder, but which taken together and in their relation to each other have a diagnostic value.

The symptoms of inflammation of the bladder are local phenomena. There are no general constitutional symptoms which *per se* are characteristic of the disease. It is impossible in a brief clinical article to describe separately the symptoms in each of the clinical types. I shall therefore describe separately the principal symptoms of inflammation of the bladder, calling special attention to their physiology and to the variations to which each is subject in the different forms of the disease, and to their diagnostic value.

There are three principal symptoms which, when they are all present,

are characteristic of inflammation of the bladder. These are, *frequent micturition*, *pain*, and *pus in the urine*. These symptoms vary in their evolution, in their intensity, in their duration, and in their relation to one another. The presence of any one of them is not distinctive of inflammation of the bladder. Their clinical importance depends upon the presence of two or more of them in the same case, and upon the relations which they sustain to each other. Pus in the urine is the only symptom which is never absent in the cystites.

Another important symptom is *hæmaturia*. This symptom, although very common, especially when the cystitis is acute, may not occur during the entire course of the disease.

In addition to these four symptoms there are others which occur more or less frequently. These are: First, modifications in the character of the urine, such as albuminuria and ammoniacal decomposition; second, changes in the character of micturition; third, certain general constitutional symptoms. The latter, however, are rather the result of the complications of cystitis than symptoms of inflammation of the bladder.

Frequent Micturition.—This is a constant symptom in cystitis, unless there is atony or paralysis of the bladder. Its intensity varies according to the sensibility of the bladder—according to the degree of local congestion. The desire to pass water, therefore, is much more frequent when the inflammation is acute than when it is chronic. In certain cases of acute cystitis the desire to pass water may occur so frequently as to be mistaken for incontinence of urine. In the cystites of prostatics the desire to pass water is usually more frequent during the night than during the day. In nearly all cases of inflammation of the bladder, whatever the cause, the desire occurs with greater frequency when the patient stands. Exercise or jolting, as by driving or riding, usually increases the desire to pass water, especially in the cystites of calculus. The desire to pass water is made more frequent by anything which increases the congestion of the bladder. Frequent micturition is not due to diminution in the anatomical capacity of the bladder, nor is it induced by the contact of the urine with the influenced mucous membrane. In certain cases, however, which I have mentioned in the section on pathological anatomy, under the title of Contracture of the Bladder, the *anatomical* capacity of the bladder is diminished as the result of prolonged interstitial suppuration. In cases of acute cystitis the desire to pass water increases in frequency as the disease progresses, because each act of micturition increases the local congestion of the organ.

Pain.—Pain, as a symptom of cystitis, is of two kinds, spontaneous and provoked.

Spontaneous Pain.—The symptoms of pain and frequent micturition are closely related to each other, the intensity of both depending upon

the sensibility of the bladder. As a rule, the more frequent the desire to pass water the more intense is the pain. In many cases the pain is most severe at the moment immediately preceding the act of micturition, and is due to the tension produced by the urine in the bladder, and is usually relieved to some extent by the discharge of urine. In many cases, especially in acute gonorrhœal and calculus cystites, the pain is most intense at the end of micturition, and continues after the act; the desire to pass water is increased greatly by violent and repeated contractions of the detrusor muscle, and is accompanied by ano-vesical tenesmus. Pain at the end of micturition also is a marked symptom in the acute cystites of prostatitis. In certain cases in which there is ammoniacal decomposition of urine, pain during the act of micturition is especially severe, on account of the passage of the altered urine through the urethra. As has been shown already, the sensibility of the bladder to the contact of irritating fluids is much less marked than that of the urethra, but the contact of ammoniacal urine with the urethral mucous membrane usually causes pain, although the same urine produces no sensation in the bladder. In addition to the pain associated with the act of micturition, there is in many cases a feeling of weight and heaviness above the pubis and in the perinæum which is referred to the bladder.

Provoked Pain.—The normal bladder, as has been said, is almost wholly insensitive to the contact of unirritating fluids and to the contact of solids. The sensibility of the inflamed bladder, on the contrary, is very intense; if the contact be violent or repeated, it produces, in addition to pain, a desire to pass water, the latter being due to the contraction of the detrusor muscle. The sensibility to tension of the inflamed bladder is always increased. The injection of even a small quantity of an unirritating fluid into a bladder that is acutely inflamed causes an intense and painful desire to pass water. This increased sensibility of the inflamed bladder both to contact and to tension is characteristic of cystitis, and may be taken advantage of in doubtful cases for purposes of diagnosis.

Pus in the Urine.—The presence of pus in the urine is a constant symptom of cystitis; its absence is positive evidence that the bladder is not inflamed. The amount of pus is very variable; at the very beginning of a cystitis it may be so small and so intimately mixed with the urine as to be imperceptible to the naked eye, and can only be discovered with the aid of the microscope. When pus is present in sufficient amount to be perceived by the eye, it is mixed with the entire quantity of urine, giving to the latter a cloudy appearance. If all the urine passed at a single act of micturition be received into three separate glasses, the larger part of the fluid being passed into the first glass, the pus in the first glass may be relatively greater than that in the second or third, or there may be a larger

amount of pus in the first and third glasses than in the second. Pus is always found in the third glass when there is cystitis. When the urine passed at the beginning of micturition contains a relatively larger amount of pus than that passed at the middle or at the end of the act, it is an evidence that the prostatic urethra and that portion of the bladder nearest the internal urethral orifice is the principal seat of the inflammation. On the other hand, a relatively large amount of pus at the end of micturition is not characteristic of inflammation of the base of the bladder, for it may be due to inflammation of the body of the bladder. The pus from this latter portion naturally flows toward the base, and is expelled therefore at the end of micturition. A large amount of pus in the urine passed at the end of micturition is therefore not a symptom of much value in determining the seat of the vesical lesion.

The appearance of the pus in cystitis varies. When the urine is acid, as it is at the outset of an acute superficial cystitis, the part passed in the first glass may contain, in addition to the free pus which appears as a cloud in the urine, shreds from the urethra. In the second glass the pus is intimately mixed with the urine and gives it a uniformly cloudy appearance. The sediment in both of these specimens consists of a more or less dense white precipitate, which settles to the bottom of the glass, and above there is a superficial floating cloud composed of mucus-pus. In the urine received in the third glass the pus is more plentiful than in the second, and in certain cases, at the end of the act of micturition, there may be passed a number of drops of pure yellow pus, or of pus mixed with blood.

In cases of cystitis associated with ammonuria, the action of the ammonia upon the pus converts it into a glairy, mucilaginous substance, which adheres to the mucous membrane of the bladder or to the bottom of the vessel into which the urine is passed. The appearance of this glairy material is extremely characteristic of that form of chronic inflammation of the bladder to which the term "vesical catarrh" has been given.

Blood in the Urine.—Blood in the urine is not a constant symptom of cystitis. It is a symptom of intense congestion, and therefore usually occurs when the inflammation is acute. The cause of the blood is due to the rupture of the smaller capillaries in the upper layers of the mucous membrane. The diagnostic importance of this symptom depends upon the circumstances under which the hæmorrhage occurs, and whether the blood was passed at the beginning or at the end of micturition, or is equally distributed throughout. Blood may discolor the entire quantity of urine passed at a single act of micturition, it may appear only in the urine passed at the end of the act, or it may follow the discharge of the last few drops of urine. It may be passed as clots or in the fluid state. In color it may be a bright or dark red, or, in cases where there is

ammoniacal decomposition, the blood may appear as a dark brownish or blackish material, which rapidly sinks to the bottom of the vessel into which the urine is received. The amount of blood passed at any time depends very much upon the cause of the hæmorrhage; it is usually increased by exercise and decreased by rest. The hæmorrhage may be provoked by the contact of instruments or by distention with fluids. When blood precedes the flow of urine it is not a sign of vesical disease, but is due to disease in the urethra or in the prostate.

The source of blood in general may be determined by employing the test with the three glasses described above. In acute cystitis blood usually follows the act of micturition, and is the result of the forcible contraction of the bladder walls upon each other. In the cystites of calculus hæmorrhage likewise is most marked at the end of micturition, as the result of the contraction of the bladder upon the stone; it is increased, as a rule, by exercise and by jolting, and in some cases by distention. In the cystites of tumor, blood is mixed with the whole quantity of urine passed, the hæmorrhage being increased by distention of the bladder, and by its contraction at the end of micturition. In the cystites of tuberculosis and of tumor there is often a history of hæmorrhage preceding the occurrence of the cystitis.

Albuminuria.—Albuminuria is not a constant symptom of cystitis; when it occurs early in the course of the disease, it is usually due to the presence of blood in the urine or to renal disease. The pus-corpuscles usually do not yield albumin in a sufficiently large quantity to be appreciated. Albumin, as the result of inflammation of the bladder, when there is no blood in the urine, does not usually occur until the disease has been present for some time. When albumin is found in urine in which there is not sufficient blood to be appreciated by the naked eye, a further examination with the microscope should be made. When there is no blood in the urine, and where the kidney is free from disease, the cystitis is usually of long standing, and the upper layers of the epithelium have been destroyed over a greater or lesser area, thus allowing the serum of the blood to escape into the bladder.

The amount of albumin found in the urine of cystitis when there is no blood or renal disease is very small. When ammoniacal decomposition is present, it sometimes is difficult to detect the presence of albumin in the urine.

Ammoniacal Fermentation.—Ammoniacal decomposition of urine is a fermentative process due to the growth and development of certain microbes in the urine. Nearly all the microbes found in normal and pathological urine are to a greater or lesser degree ammoniogenous. By the decomposition of urea, carbonate of ammonia is set free, and the latter, acting upon the pus, converts it into a thick, glairy, gelatinous mate-

rial, which sinks rapidly to the bottom of the vessel into which the urine is passed. When this change occurs, the urine is strongly alkaline and has a very fetid, ammoniacal odor, and is of a sirupy consistence, due to the changed condition of the pus.

Ammoniacal decomposition of urine formerly was regarded as the cause of cystitis, and this theory is still entertained by some authors. It has been proved conclusively, however, by the investigations of Guiard and Guyon, that ammoniacal decomposition is a symptom and not a cause of cystitis. It occurs in cystitis only when, in addition to the presence of ammoniogenous microbes in the bladder, there is either complete or partial retention of urine.

The condition of the urine and the amount of pus are important factors in the production of ammoniacal decomposition. When urine is of low specific gravity—that is, contains little urea—and of acid reaction when it enters the bladder, the fermentative process is slight. A relatively large amount of urea and of pus in the urine favors ammoniacal decomposition. The effect of this fermentative change is to increase the intensity of the cystitis, owing to the irritating qualities of the carbonate of ammonia set free. Ammoniacal decomposition in the bladder is pathognomonic of cystitis.

Diagnosis.—A thorough diagnosis in every case of cystitis is of the utmost importance. Cases are often treated for cystitis when there is no inflammation of the bladder, the diagnosis having been made upon a single symptom. In order to treat a cystitis intelligently it is necessary to know, in addition to the fact that the bladder is inflamed, its cause, its intensity, the anatomical and physiological state of the bladder, and the character and extent of its lesions.

To determine whether the bladder is inflamed is usually an easy matter. Frequency of passing water, and pain associated with the discharge of pus in the urine, make the diagnosis of cystitis probable. None of these symptoms alone, however, are distinctive of cystitis. Frequent micturition is a common symptom in almost every disease of the urinary tract. Painful micturition, resembling that which occurs in cystitis, may result from a calculus in the pelvis of the kidney, or from certain nervous affections of the bladder, or from inflammation of the prostatic urethra, the bladder itself being entirely free from inflammation. Pus in the urine is a symptom of any local infection of the urinary tract. The diagnostic importance of pus in the urine depends upon its source. In every case where cystitis is suspected the urine should be examined in three glasses, as described above. When pus is found in relatively larger quantities in the first and third glasses than in the second, the presence of cystitis may be assumed, especially when there is associated with this symptom pain and a frequent desire to pass water. A large quantity of

pus at the end of micturition may be misleading, since this is found in certain cases of pyelitis. In the latter case, however, the urine usually retains its acid reaction; whereas in cystitis, the urine is usually neutral or alkaline.

The microscopie examination of the urine is of great value in determining the presence of cystitis, and it should be made in every case. The presence of the cystitis may be determined in this way by the character of the epithelium, and possibly by the character of the micro-organisms found in the urine. Ammoniacal decomposition of urine, when present, is a sure symptom of cystitis. In order to establish the diagnosis of inflammation of the bladder, it is necessary often to make a physical and instrumental examination of the patient. If pressure by the finger be made upon the neck of the bladder through the rectum in cases of cystitis, it will cause pain in proportion to the intensity of the inflammation. The sensibility of the inflamed bladder to the contact of solids may be taken advantage of in doubtful cases. A sterilized *bougie à boule* or a searcher brought into contact with the mucous membrane of the inflamed bladder causes pain. So also the increased sensibility of the bladder to tension is diagnostic of cystitis. This may be determined by the injection of fluids into the bladder.

The cause of a cystitis can be determined usually from the history of the case. In young or middle-aged persons cystitis is usually the result of urethral inflammation. A history of recent gonorrhœa or chronic urethritis is suggestive of this form of cystitis. In cases where there is a history of previous disease of the urethra, examination of the urine or an instrumental examination of the urethra may discover a lesion in the deep urethra, from which the bladder has been infected. In the cystites of stricture there usually is a history of progressively increasing difficulty in micturition or of sudden retention of urine. The occurrence of ammoniacal decomposition of urine in the bladder of a patient under fifty years of age can be taken as evidence of probable stricture cystitis. In a patient over fifty years of age, where preceding the cystitis there is a history of frequent micturition, the desire to pass water being more frequent at night than during the day, prostatic cystitis may be inferred. Rectal or instrumental examination of the urethra will determine this point. In the cystites of tuberculosis and of tumor there is often a history of hæmorrhage preceding the occurrence of the inflammation. A cystitis in which the cause can not be determined by the most careful examination should suggest its tuberculous origin, and repeated examination should be made for the tubercle bacilli.

The intensity of a cystitis may be determined by the symptoms of pain and frequency. The more intense the cystitis, the greater the pain, and the more frequent the desire to pass water. Hæmorrhage is also a

symptom of the intensity of a cystitis, especially when the blood appears at the end of the stream.

It is necessary, in addition to the points mentioned above, to determine also the anatomical and physiological condition of the bladder, especially as to its power to discharge completely its contents, and as to its capacity to retain fluids. In cases of cystitis due to stricture or to enlarged prostate, it is important to ascertain the amount of residual urine. This can be done by the introduction of a catheter into the bladder, after the patient has passed all the urine that he can. In cases where the muscular power of the bladder is diminished as the result of overdistention (atony) the flow of the urine through the catheter will be slow. The degree of atony may be ascertained by placing the patient upon his back, and by instructing him to take a deep breath while the urine is flowing through the catheter. This will cause an acceleration in the flow of urine when atony is complete. In cases of acute cystitis the contractility of the bladder is greatly increased, and urine is discharged through the catheter very forcibly. In cases of chronic cystitis in which the sensibility of the bladder is not greatly increased, and where there is hæmorrhage the cause of which can not be determined by the ordinary means of examination, a cystoscopic examination should be made in order to ascertain its source.

Prophylaxis.—In view of the facts already presented, it is evident that inflammation of the bladder is never a primary affection, but is always secondary to some pathological state of the urinary tract, and that the determining cause of a cystitis not infrequently is the careless or improper surgical treatment of this condition.

According to the doctrines of surgical pathology relating to suppurative lesions, the following general principles may be formulated: First, all operations or surgical procedures, however slight, should be performed with thorough aseptic precautions; and, secondly, all pathological states of the urinary tract which favor the local infection of the bladder should be removed as soon as possible and with the least mechanical violence.

Under the first of these heads I may call attention briefly to the method of performing operations aseptically upon the urinary tract. In the first place, the external genitals, especially the glans penis and the cavity of the prepuce, should be thoroughly cleansed and washed with an antiseptic solution, such as Thiersch's fluid. The pendulous and bulbous portions of the urethra should be thoroughly irrigated with Thiersch's solution.

In cases where the anterior urethra is inflamed, although it can not be rendered thoroughly aseptic by irrigation, the chance of infecting the bladder from the urethra by the introduction of instruments is greatly lessened when the attempt is made.

Preparation of Instruments.—All instruments should be sterilized by boiling, or by passing them through the flame of an alcohol-lamp. The soft instruments, catheters, etc., should never be immersed, even for a short time, in any of the stronger antiseptic solutions, such as solutions of bichloride of mercury or carbolic acid.

The following simple rules for sterilizing catheters will be found efficient: The instruments, having been washed in hot water, should be boiled for about twenty minutes in a solution of chloride of sodium, one drachm to the ounce. Upon their removal from this solution they should be dried with sterilized gauze, and should then be placed in a case made of sterilized Canton flannel or gauze. Before using, the catheter should be placed for a moment in boiling water.

Local infection of the urinary tract occurs frequently, I believe, from the use of unsterilized oil employed for the purpose of lubricating instruments. In order to avoid this, the oil used should be sterilized by boiling.

Treatment.—In the treatment of the cystitis the principal general indications are: 1. To remove the cause. 2. To relieve the pain and frequent micturition by subduing and preventing local congestion. 3. To modify the character of the urine, so as to prevent as much as possible the development in it of pathogenic microbes. 4. To control suppuration.

Treatment is both medical and surgical. The latter is of the most importance, but in nearly all cases medicinal remedies are indispensable.

In most cases it is necessary to use some form of intravesical medication, and, although in certain cases the disease will subside under medical treatment alone—providing the cause is removed—still the proper use of local treatment makes the cure more certain and more rapid.

In every case of cystitis we should seek to discover whether the inflammation is the result of a urethritis, acute or chronic, or of stricture, or of an enlarged prostate, or of a vesical calculus, or of tumor of the bladder, or of tuberculosis, etc.; and when we have decided that any one of these conditions is present, it should be removed if possible. In nearly all cases of inflammation of the bladder surgical interference is necessary to remove the cause—the use of a sound, or the introduction of a catheter, internal or external urethrotomy, litholapaxy, lithotomy, cystotomy, and deep instillations, are among the various operations which are thus indicated. There are two questions of importance to which I desire to call attention in this connection. The first of these is in regard to the risk of operating upon the urinary tract of cystitis, and the second relates to the choice of operation.

To regard cystitis as a contraindication to operative procedure is an error. So long as the cause of a cystitis remains, it is impossible to

cure the inflammation, and clinical experience shows that the removal of the cause by operation, when properly and aseptically performed, is much less dangerous than to allow the cystitis to continue. It is true that the intensity of a cystitis may be increased by surgical operations improperly and unskillfully performed to remove the conditions which favor local vesical inflammation, and that disregard of aseptic precautions in these operations may expose the patients to serious risk. On the other hand, if these causes are not removed, disease of the kidneys and general urinary infection may occur. But, although a prompt removal of the cause is imperatively demanded to cure a cystitis, there are certain conditions in which it is advisable to postpone the operation, but not to abandon it.

In calculus cystitis, when the inflammation has been intensified from any cause, the operation may be postponed until the acuter symptoms have been subdued by appropriate treatment.

The conditions which determine the choice of operation are fully considered in the article on Stone in the Bladder.

In the cystites of stricture the question of operation and the choice of the method depend upon the character of the stricture, the intensity of the cystitis, and the anatomical and physiological condition of the bladder. In cases of acute retention of urine due to stricture the surgeon has no choice: the bladder should be relieved at once, and its thorough and regular evacuation insured for the future. The operative treatment of stricture is fully treated in the article on Stricture of the Urethra.

Speaking generally, dilatation should not be performed when, in spite of thorough asepsis, the cystitis is increased by the introduction of an instrument, or where dilatation is followed by urethral or urinary fever. Nor should gradual dilatation be resorted to when there is retention of urine, unless it is possible at the time the urine is drawn to overcome the obstruction sufficiently to insure at each subsequent act of micturition a complete evacuation of the bladder. The choice between external and internal urethrotomy, I believe, should be determined by the intensity of the cystitis as much as by the character of the stricture.

Rest and General Hygienic Treatment.—In the treatment of any local inflammation, rest and position are important factors. The special indication for rest is the character and severity of the pain, the object of rest and position being to relieve this symptom by decreasing the congestion. When the pain is intense, or there is much hæmorrhage, the patient should not get up, even to pass water or go to stool. The desire to pass water, and the pain, may be relieved in many cases by placing the patient upon his back, with the thighs and knees flexed, this position being maintained more easily by supporting the knees with a firm cushion or pillow. In this way pressure upon the bladder is removed. Pain is often lessened if the patient lie upon his side when making water.

The diet of cystitis is an important factor in the treatment. The food should be bland in acute cases, and to a large extent should consist of fluids. When milk agrees, it is best to confine the patient to this diet exclusively until the acuter symptoms subside; the milk may be mixed with Vichy or any of the carbonated waters, and taken *ad libitum*. In chronic cases the diet may be more varied, but the food should be easy to digest, and all stimulating condiments, such as curry, mustard, and vinegar, should be avoided; green vegetables and ripe fruits can be taken with advantage. Asparagus and rhubarb are harmful in some cases. The ordinary nonalcoholic beverages may be taken, but those which contain much sugar should be avoided. Most careful attention should be given to the condition of the lower bowel, which should be emptied at least once a day without straining. An enema of hot water, or a dose of Carlsbad salts or of Hunyadi water before breakfast, or a mild laxative should be given at bedtime. The constipation certain to result from the use of opium should be counteracted by a laxative, and in addition to the latter an enema should be given before the stool. Cystitis should avoid violent exercise, both because the latter causes an increased excretion of urea, and therefore favors ammoniacal decomposition, and also because when overheated the surface of the body is likely to become chilled by any sudden change of temperature, and the congestion of the bladder thereby increased. The use of alcoholic stimulants is contraindicated in the cystitis, except in chronic cases where the patients are old and feeble, and where the habit of using stimulants has been long indulged. Sexual intercourse and sexual excitement are to be avoided, and to this rule there are no exceptions.

Although the cause of a cystitis is the principal factor in determining its treatment, the intensity of the inflammation, and in a less degree the character of the lesions, indicate the special mode of treatment. The intensity of a cystitis depends upon the degree of local congestion, and is indicated clinically by the symptoms of pain and frequent micturition.

The Use of Anodynes.—In the treatment of pain and frequency, the remedy *par excellence* is opium and its alkaloids. The use of opium should be regarded as a temporary form of treatment, which in most cases must be accompanied or followed by local treatment of the bladder. The choice of the method of administration depends upon the effect which is to be produced, the length of time during which the drug is to be employed, and the effect which it produces upon the digestive tract. It should be given by mouth or rectum when it is necessary to employ the drug for several days. The use of rectal suppositories of opium, with or without belladonna, is a valuable method when the drug is not well borne by the stomach. Opium is indicated in all cases of cystitis in which the symptoms of pain and frequency are severe, and in

which the former is not relieved by rest and hygienic treatment. The more intense the pain, the greater the indication for the opium, and to hesitate to give it is a serious mistake. In acute gonorrhœal cystitis, and in the cystitis of calculus, where the pain is severe, the use of opium is indispensable. In most cystitis the pain and frequency create a tolerance to the drug which is in proportion to the symptoms. In administering the drug, provided the patient has no known idiosyncrasy which contraindicates its use, no limit should be placed upon the dose, the object being to give rest to the bladder, the dose should be repeated sufficiently often to accomplish this. Its use, however, as I have said, should be temporary. In most cases of acute cystitis it is not necessary to continue the drug more than three or four days, when it is combined with intelligent local and hygienic treatment.

Instillations.—There are two modes of intravesical medication in the treatment of cystitis, exclusive of those which necessitate the performance of cystotomy. These are, first, injections; and, second, instillations. Injections are contraindicated in all cases where the bladder can not retain at least an ounce of fluid without creating a desire to pass water, and in all cases associated with great pain and frequency of micturition. The use of injections in acute cystitis is certain to intensify the inflammation, owing to the pain and increased muscular effort which the introduction, of the fluid provokes. Instillations, on the contrary, are useful in all inflammations of the bladder, but especially in those conditions in which injections are contraindicated. The lesions of cystitis are usually most intense in the prostatic urethra and the neighborhood of the trigone. Fluids injected into the deep urethra flow backward into the bladder. These facts are taken advantage of in the treatment by instillation. A few drops of fluid are introduced into the prostatic urethra when the bladder is empty, and thus are brought into contact with its inner surface.

Instillations of the nitrate of silver made with Ultzmann's or Keyes's deep urethral syringe, give the best result. Instillations of solutions of bichloride of mercury in the tubercular cystitis have been recommended by Guyon. I have not found these of any greater value than those of the nitrate of silver. The bladder should always be emptied immediately before the instillations are made. Nitrate of silver is valueless in certain cases of tubercle cystitis.

The immediate effect of the nitrate-of-silver solution upon the bladder is to cause contraction of the detrusor and increase the desire to pass water. When the inflammation is intense, it is sometimes necessary to control the pain caused by the first instillation by a hypodermic injection of morphia. The pain, however, if the solution is not too strong, is temporary, and soon passes away. The congestion that immediately follows the application of the nitrate of silver and causes the symptoms of pain and

frequency is followed by a reaction, and within a few hours the congestion is reduced and the pain and frequency appreciably relieved. Exaggerated tension sensibility of the bladder is likewise blunted. The best effect is obtained by the frequent use of weak solutions, rather than by stronger solutions used at longer intervals. The action of the instillations in cystitis is analogous to the effect produced by the drug in conjunctivitis. In beginning treatment, a solution of one grain, or even one half grain, to the ounce should be used and the effect produced by this noted. If the solution is too strong, pain and a desire to pass water will continue for several hours. The pain does not continue usually more than twenty minutes or half an hour; but in peculiarly sensitive patients this period may be longer. The strength of the solution may be increased gradually at each operation, but only in exceptional cases is it necessary to use solutions of greater strength than eight or ten grains to the ounce. In acute gonorrhœal cystitis, where this mode of treatment is peculiarly valuable, from one to four grains to the ounce is usually strong enough. When a solution of a given strength is found to relieve pain, the strength should not be increased until the weaker solution fails to produce the effect desired. The amount of fluid injected should not exceed twenty-five or thirty minims. Instillations of ten minims are usually sufficient, especially at the beginning of a course of treatment. In the treatment of acute cases the instillations can be repeated every day or every other day, according to the effect produced.

Instillations of the silver nitrate in the treatment of cystitis are of more value than other forms of local treatment in the vast majority of cases.

Instillations are contraindicated in the cystites of stricture, when the caliber of the urethra is much diminished. In the cystites of prostatics they often may be combined with injections.

Baths and External Applications.—The use of baths and hot-water applications over the hypogastrium and perinæum are of unquestionable service for the relief of pain in the treatment of acute cystitis. To be of any service, the bath should be hot, at a temperature of 100° to 110° Fahr. The patient should not remain in the bath over ten minutes. Poultices, or the application of the hot-water bag over the bladder or perinæum, are often very comforting.

Local Anæsthetics.—The application of local anæsthetics to the mucous membrane of the bladder is, I believe, of little value in the treatment of cystitis. Intravesical injections of cocaine have only a temporary effect, and the ultimate result of these injections is to increase the congestion. The same is true of intravesical injections of opium or morphia.

Vesical Drainage.—There are two forms of vesical drainage: first, temporary; and, second, permanent.

There are three modes of employing the temporary form of vesical drainage: 1. By way of the urethra. 2. Through the perinæum. 3. By suprapubic cystotomy.

Drainage through the Urethra.—This mode of vesical drainage is made by introducing a catheter into the bladder through the urethra. The best catheter to employ for this purpose is the Guyon's drainage catheter, which is open at both ends. It should be of small size, not larger than No. 16 French. Before introducing it, the catheter should be thoroughly sterilized and the urethra washed out. This mode of drainage is of little value in the cystitis, and should be employed only as a temporary expedient. The indications for its use in the treatment of cystitis are after operations upon the urethra, to prevent the contact of purulent urine with the wound, and in cases of difficult catheterism.

The Perineal Method.—This consists in opening the membranous portion of the urethra in the median line of the perinæum, and through this opening introducing a large rubber catheter (No. 27 to 32 French) into the bladder. The latter is kept in place by means of tapes, which are tied about it as near as possible to the edges of the perineal wound, and the ends of these are then secured to a broad waistband.

It is unnecessary for me to describe here the operation in detail, but there are certain points to which I desire to call attention. The tube should have only one eye, which should be as near to the extremity as possible. The lumen of the tube should be large without weakening its walls. When there is hæmorrhage from the bladder, or when the pus is very gelatinous, the tube should be of larger size (30 to 32 French), as otherwise it is likely to be stopped up. After opening the urethra, and before introducing the tube, the prostatic urethra and neck of the bladder should be dilated. This, in many cases, may be done with the finger or a blunt gorget, or a Sims uterine dilator may be used. This dilatation of the vesical neck is of the utmost importance, especially in cases of intense vesical tenesmus. When this is neglected, the tube causes painful contractions of the bladder, and in some cases pain and a desire to urinate so severe as to necessitate the removal of the tube. The latter should be placed so that its eye is just within the internal urethral orifice. The length of time which a tube introduced through the perinæum may remain in the bladder can not be positively stated. In a number of cases of old prostatics who were bedridden, and whose bladders were contracted, I have maintained this mode of drainage for many weeks at a time. In most cases the sensibility of the bladder to tension and the amount of pus are the best guides to determine this point. When necessary, the tube may be removed temporarily at any time after the first twenty-four hours, and replaced without difficulty. It should be kept scrupulously clean. Intravesical injections may be made through the tube. After

finally removing the tube, the fistula remaining should be refreshed by scraping its sides if the drainage has been continued for a long time. These fistulæ usually heal kindly within two weeks, providing the caliber of the urethra be maintained by passing, on every fourth or fifth day, a full-sized conical steel sound during cicatrization.

The Suprapubic Method.—Drainage of the bladder by suprapubic cystotomy may be performed either for the purpose of temporarily draining the bladder, or to establish and maintain afterward a permanent fistula through which the urine may flow. The operation of suprapubic cystotomy has been elsewhere described, and the details of its technique need not be given here. The way in which drainage should be made when the bladder is opened above the pubes is still a subject of discussion. The principal points at issue are: First, as to the number of tubes; and, second, as to their disposition and the manner of securing them in place. The method most commonly employed is that with two tubes, the bladder being emptied by syphonage. This mode of drainage is undoubtedly the best. One of the tubes can be removed at any time, while the other is retained. When both tubes are removed finally, it is best for the first few days to empty the bladder by the use of a catheter; the fistula remaining closes gradually.

Permanent Drainage.—Various methods of establishing permanent drainage of the bladder above the pubes have been suggested. At present, the rules which should govern the choice of a method can not be stated definitely. The best method at present is that which consists in introducing a soft-rubber catheter, bent at an angle, through a fistula previously established above the pubes, and securing it in place by passing it through a hard-rubber pad which is molded to the surface, the pad being secured by tapes passing around the waist. Permanent drainage is indicated in cases of cancer or in cases of very difficult catheterism in prostatics. The choice between permanent drainage and prostatectomy presents itself in these cases.

Indications and Choice of Operation.—Drainage by suprapubic cystotomy is to be preferred to the perineal method in most cases where an operation is undertaken for the removal of morbid growths or foreign bodies; but unless during the first few days the attendance of a competent nurse can be secured, the perineal method is to be preferred even in these cases. It has been claimed that the division of the detrusor muscle in the suprapubic operation is an advantage in cases of cystitis with intense pain. The same relief, however, may be obtained, I believe, in most cases from the perineal operation, providing the vesical neck be thoroughly dilated.

Vesical drainage through the perinæum is to be preferred in most cases of cystitis. Its advantages over the suprapubic method are: First,

that the operation is safer; second, that, if necessary, it may be performed under local anæsthesia (cocaine); third, that it is more rapidly performed; fourth, that the tube requires less care subsequently than when suprapubic cystotomy is performed.

Vesical Dilatation.—The theory that the capacity of an inflamed bladder can be increased by dilatation is contrary to physiology and anatomy. To attempt by forced injections to relieve frequent micturition can not be too strongly condemned, and it is a surprising fact that this method of treatment should be suggested at the present day by any author.

Treatment of the Urine.—As before stated, the normal urine in health, as it flows from the kidney, is an aseptic fluid. In cystitis, the urine, upon being discharged into the bladder from the kidneys, becomes modified by the pus, and serves as a medium for the development of pathogenic microbes. When there is obstruction to the outflow of urine, causing partial or complete retention, the fluid undergoes ammoniacal fermentation. Three factors are necessary to cause this change: 1. The presence of ammoniogenous microbes in the urine. 2. The presence of pus. 3. Retention or stagnation of urine.

This is the result, as I have shown, of decomposition of urea, caused by the development in the fluid of certain micro-organisms. The carbonate of ammonia set free by this fermentation acts as an irritant upon the inflamed mucous membrane. This decomposition of urine within the bladder is pathognomonic of cystitis. It occurs, however, only when in addition to the pus and microbes there is also stagnation of urine. This condition is favored by the amount of urea which the urine contains, as well as by the amount of pus.

Since the growth and development of micro-organisms in the urine are favored by the quantity of urea which the latter contains, the object in treatment should be to diminish the quantity of urea, and to increase proportionately the amount of water. This is best accomplished by attention to the rules of diet which have already been given, and by the use of certain mineral waters and diuretics. The Poland, Bethesda, Contrexéville, and Vichy waters are the best for this purpose. These should be taken in large quantities between meals, and in some cases may be advantageously combined with the use of saline diuretics, the citrate of potassium being the best. It is a mistake, however, to give doses of the latter sufficiently large to make the urine alkaline, as this favors infection.

The second indication is to render the urine antiseptic by the use of certain remedies which are eliminated through the kidneys. Salol and salicin, either alone or in combination, in from five to fifteen grain doses, three times a day, may be given with advantage. Naphthalin, in doses of from two to five grains, three times a day, in the form of capsules, acts

well in some cases; and the same in true of the oil of gaultheria, in doses of from five to fifteen minims. The latter, combined with salicin, is specially indicated in cystitis occurring in patients who are gouty or rheumatic. The oil of sandal-wood and the balsam of copaiba in the treatment of the cystitis are not of much value. In cases of ammonuria, in addition to the treatment just indicated, it is necessary to prevent stagnation of urine by the regular and thorough evacuation of the bladder.

Intravesical Injections.—These are of two kinds: First, those used for the purpose of cleansing the bladder; and, second, those used to produce some local effect upon its mucous membrane.

The value of intravesical injections in the treatment of cystitis is very great. They are contraindicated, however, in many cases, and should not be used indiscriminately in all forms of the disease.

Fluids used for Injections.—In washing the bladder the fluid used should be aseptic, should be hot (temperature 100° Fahr.), and should contain no solid particles. The best fluids for the purpose are Thiersch's solution; a solution of borax, one drachm to the pint; a saturated solution of boracic acid; a solution of chloride of sodium, two drachms to the pint; and a solution of peroxide of hydrogen, of three or four volumes, or stronger. The stronger antiseptic solutions, such as those of corrosive sublimate and carbolic acid, should never be used within the bladder. All the fluids mentioned above are useful, and each has advantages in certain cases.

Washing the bladder is indicated where there is ammoniacal fermentation of the urine, if the sensibility of the bladder to tension is not very much increased. In such cases, especially where the ammoniacal fermentation has been of long standing, the best results are obtained from injections of Thiersch's solution. For ordinary cases I prefer this or the borax or boracic-acid solutions. The use of all these, however, may be followed in some cases by a feeling of irritability or a burning sensation in the bladder. In such cases the simple salt solution, made with boiled water, may be employed. The peroxide of hydrogen is of value in cases of hæmorrhage, where there are organized clots in the bladder. These are disintegrated by the action of the peroxide, and the bladder then may be washed clean with less chance of congestion. It may be stated as a general rule that the solution used for washing the bladder should never cause any pain, nor excite increased effort of the detrusor muscle.

In washing the bladder, the latter should never be distended to its physiological capacity; in other words, the fluid injected should not cause pain or a desire to pass water. An injection of two ounces of fluid or less is usually sufficient to inject at one time, and the fluid should be immediately withdrawn. The operation may be repeated as

often as necessary. A number of small injections in succession clean the bladder far more rapidly than the injection of a large quantity of fluid. When withdrawing the fluid, care should be taken to have as little of the catheter within the bladder as possible, so that the softened mucous membrane may not be forced against the instrument when the bladder becomes empty. The frequency with which the bladder should be washed depends upon the state of the urine and the degree of the cystitis; the object of this mode of treatment is to prevent or to stop ammoniacal decomposition by the removal of the pus, and to arrest the development of pathogenic germs in the urine. Once or twice daily is sufficiently often for washing the bladder in most cases, and after ammoniacal fermentation has been arrested the operation may be performed less often.

The danger of infection from disregard of asepsis in this operation, the danger of increasing the congestion by overdistention of the bladder, and the danger of injury to the bladder from the rough use of instruments or the use of improper instruments, should be kept in view constantly. The urethra should be irrigated before each washing.

Contraindications.—An injection should not be repeated when the moderate distention of the bladder necessary to the operation causes pain or an increased desire to pass water. In cases of acute cystitis, without retention of urine, injections are contraindicated.

Nitrate-of-Silver Injections.—The second class of injections are those used for the purpose of producing some local effect upon the mucous membrane of the bladder. A great number of remedies have been employed for this purpose. I have already said that the use of the more powerful antiseptic solutions, and of solutions for producing local anæsthesia, are contraindicated in the treatment of cystitis. By far the best injection of the second class is that of a solution of silver nitrate. This remedy, as are all forms of intravesical injections, is contraindicated when there are pain and frequent micturition, or when the inflammation is acute. The strength of the solution to employ in the bladder is much weaker than that used by instillation. From one quarter to one half a grain to the ounce is strong enough to begin with. The strength of the injection may be gradually increased, if necessary, up to two grains to the ounce. In using nitrate-of-silver injections the bladder should be washed out first, and then completely emptied. The amount of the nitrate-of-silver solution should not exceed two ounces, and should be permitted to escape immediately. These injections may be given as frequently as every other day, if required. This mode of treatment is specially indicated in cases of chronic inflammation associated with ammonuria, where there is a large discharge of pus in the urine.

INJURIES AND DISEASES OF THE BLADDER.

By GEORGE RYERSON FOWLER, M.D.

I. WOUNDS OF THE BLADDER.

CONTUSION OF THE BLADDER.

THE elasticity of the anterior abdominal walls weakens to a very considerable extent the force of blows directed over the region of the bladder. The fact that the bladder wall itself, unless the cavity be filled with urine, offers but slight resistance to force applied from in front alone, serves as a still further protection against serious contusions or rupture. In a bladder overfilled and with tense walls, both vesical and abdominal, as frequently occurs in drunken men, a kick or a blow may result in any form of injury, from a slight contusion to complete rupture.

In a contusion of the vesical wall a greater or less number of blood-vessels in the mucous membrane may be torn, and blood enter the cavity of the bladder as a result. This constitutes the condition known as vesicular hæmaturia.

Symptoms and Diagnosis.—The diagnosis of contusion is easily made. The urine clearly shows the presence of blood. Injuries and diseases of the kidneys with hæmorrhage into the capillary canals, and of the renal pelvis, may produce similar discoloration of the urine. In these cases, however, the blood-pigment, before leaving the bladder, is of a brownish color, while in cases of vesicular hæmaturia due to contusion the urine is blood-red. In cases of renal hæmaturia, microscopical examination reveals the presence of red blood-corpuscles in a very much shrunken condition; while in case of hæmaturia following contusion the corpuscles are colorless, swollen, and globular. In vesicular hæmaturia, also, small fibrinous coagulations of a blood-red color are observed; fibrinous coagulations of kidney origin are deprived of their color before leaving the body. In case of contusion of the bladder, the entire organ may be filled with large blood coagula.

Immediately following the occurrence of a contusion of the bladder of any considerable extent, symptoms of vesical irritability and tenesmus arise. The impulse to empty the bladder is strongly felt, and repeated attempts, with bearing-down efforts, are made. The bladder is but in-

completely emptied in some instances, owing to the presence of clots checking the outflow of urine. Attempts to empty the bladder by means of the catheter may be frustrated, owing to the fact that the eye of the instrument becomes occluded by the presence of coagula. Water forced through the catheter may serve to clean it for the time being.

The principal dangers of contusion of the bladder are two in number. These are: first, decomposition of blood in the bladder; and, second, persistence of the hæmorrhage to a dangerous extent. The first named may arise from the accidental introduction of germs of putrefaction from the urine itself, or from the use of a non-aseptic catheter. From the very ineipieney of a septic condition cystitis of a greater or less severity occurs.

Treatment.—In the treatment of contusion of the bladder the indications point to, first, providing against septic infection of the blood already escaped into the cavity of the bladder, and, second, the arrest of the hæmorrhage. The first is to be accomplished by the use of antiseptic irrigations, and, of these, that known as the boro-salicylic of Thiersch will probably be found to best answer the purpose. By this means the coagula which are retained are kept disinfected and thus rendered powerless for harm, while the *débris* from them, as they break down, are washed away. With a soft catheter and a common glass funnel connected therewith by means of a length of rubber tubing a simple irrigating apparatus may be made, and the process repeated, if gentle manipulation be employed, a number of times daily, until the dangers of septic cystitis are passed.

In cases of hæmorrhage from external injuries hæmostatic measures are, as a rule, unnecessary. As soon as the distention is relieved by emptying the bladder, and the walls of the vessels resume their normal condition, spontaneous arrest of the bleeding takes place. But it sometimes happens that the accident occurs in old persons with chronically diseased bladder walls; hæmostatic measures must be resorted to in persistent hæmaturia following the injury in such.

WOUNDS OF THE BLADDER.

Gunshot injury may be taken as the type of perforating wound of the bladder. Punetured and lacerated wounds originating from other sources do not essentially differ in their course from that pursued by gunshot-wounds. Although subcutaneous wounds or rupture of the bladder will be treated of in another section, it will not be out of place to call attention here to the important fact that, as shown by a study of 285 cases of gunshot-wounds of the bladder by Bartels, there were but 65 fatal results, while of 185 cases of rupture only 17 ended in recovery. It is not difficult to account for this difference. Gunshot-wounds of the bladder almost necessarily provide for escape of urine along their track;

on the contrary, the occurrence of subcutaneous wound or rupture of this viscus is followed at once by extension and most dangerous infiltration. Although the statistics of Bartels are somewhat contradictory to those compiled from the records of the late civil war, these showing 185 cases with 96 deaths, yet the fact remains that the mortality following open wounds is not nearly so great as that which follows rupture.

A wide distinction is to be made, in the study of wounds of the bladder, between those which occur *extra-* and those occurring *intra-peritoneally*. Those involving the vesical wall at the apex of the bladder, as well as those occurring posteriorly, as a rule invade the peritoneal cavity, while in those at the lower and anterior vesical wall the last escapes. In the first group a most serious condition is present, and the patient's life is threatened from the invasion of a rapidly fatal septic peritonitis. In those cases of an extraperitoneal character, although even here the condition may become a grave one from infectious cellulitis, the prognosis is more favorable, and, inasmuch as the fatal issue is somewhat postponed, time is allowed for interference. This is particularly true in cases where the wound itself is such as to permit more or less free escape of the bladder contents. Failing in this, however, and in the absence of operative interference, a rapidly spreading infectious cellulitis, almost as fatal as septic peritonitis itself, carries the patient off within a few days.

Treatment of Intraperitoneal Wounds.—In the first class of cases—i. e., those in which the vesical wall and peritonæum are simultaneously wounded—an immediate laparotomy is imperatively demanded. Absolutely no consideration should deter the surgeon from giving the patient, and at once, the benefit of the only resource at all calculated to give him a chance for life. The same principles should govern here as in cases of perforating wound of the bowel. The abdomen is to be opened in the median line, the wound in the vesical wall sought for and sutured by means of the Lembert or Czerny suture, and irrigation of the peritoneal cavity accomplished by means of a sterilized solution of the normal blood-salts, or a chloride-of-sodium solution, one drachm to the pint. Walter, an American surgeon, was the first to put this prompt procedure into practice, and with the result of saving the patient. Following this measure a suprapubic or perineal cystotomy, or permanent catheterization may be added for the purpose of insuring drainage and removing pressure from the sutured portion of the bladder. Of these measures, the most certain to accomplish the object, when the difficulties of keeping a perineal drainage-tube or permanent catheter from becoming occluded are considered, will be found to be that of suprapubic cystotomy, combined with capillary drainage.

Treatment of Extraperitoneal Wounds.—In cases of extraperitoneal wound of the bladder the indications are to insure, at the ear-

liest possible moment, complete and free drainage of urine from the bladder, and thus prevent infiltration and infection of the para-vesicular connective tissue in the lesser pelvis, and consequent phlegmonous inflammatory deposits in remote and inaccessible regions. At the very outset, therefore, measures should be taken to explore the original wound, and, by means of a proper drainage-tube, insure free escape from the direction which it takes. This should be supplemented, without delay, by either suprapubic cystotomy and capillary drainage, permanent catheterization and siphon, or perineal cystotomy. The latter procedure will be preferable, particularly in instances in which a free flow of urine has taken place, through the rubber tube placed in the bladder through the wound itself. Under these circumstances there is an advantage in opening the bladder at its lowest point and directing the flow of urine away from the wounded portion. In cases in which urinary infiltration has already developed, attempts should be made to follow up, from the perineal or suprapubic wound, the infected planes of connective tissue and to irrigate and drain these as thoroughly as possible. If much time has elapsed since the infliction of the injury, these attempts will be found of doubtful utility.

II. FOREIGN BODIES IN THE BLADDER.

Foreign bodies may find their way into the bladder either by accident or design. In the first-mentioned class of cases are to be included instances in which efforts to titillate the sensitive urethra by those in whom the sexual apparatus is no longer responsive to natural influences. These include almost any imaginable article to be found at hand in domestic life, such as pins, needles, shoe-strings, hair-pins, pieces of wire, feathers, pipe-stems, pencils, broom-straws, etc.; in addition to these, bits of broken catheter which become detached, either through the use of defective instruments in the hands of those who have become launched upon what is known as the "catheter-life," or in the hands of those who seek to resurrect the deadened pleasurable sensations of youth by artificial stimuli.*

Symptoms.—Foreign bodies in the bladder give rise, in due course of time, by their presence, to almost precisely the same class of symp-

* Defective instruments in the hands of the surgeon may likewise be responsible for the presence of a foreign body in the bladder. The writer has knowledge of a case in which, in the course of an exploration of the urethra by means of the Otis urethrometer, the rubber cap covering the expanding portion of this instrument became detached in the deep urethra, and found its way into the bladder. Fortunately, a few days subsequently, the rubber cap became engaged, with its open extremity toward the cavity of the bladder, and its closed and pointed end at the internal urethral orifice at the neck of the bladder; it was thus expelled, distended with urine, during an act of micturition. The expulsion was accomplished with considerable difficulty.

toms as stone, such as vesical irritability, more or less pronounced ; dysuria, mainly at the end of the act of micturition, and most likely to be referred to the extremity of the penis ; alkalinity and putrefactive changes in the urine when passed. It but rarely happens that the case comes under the surgeon's notice until most pronounced evidences of their presence manifest themselves, especially in the class of cases in which the foreign body has slipped from the fingers of a masturbator. In females, particularly, foreign bodies have been removed from the bladder of individuals who have affected the most profound astonishment at their presence. In the latter, particularly in the absence of any well-defined cause affording explanation of persistent bladder symptoms, an exploration of the viscus should be made with the sound. Where this fails to reveal the presence of a foreign body, either from the fact that lithic deposits have not yet taken place, or from any other reason, cystoscopy will be found to be a valuable resource. It occasionally occurs that the patient acquaints his medical attendant at once with the nature of the accident which has befallen him, and before symptoms of a very pronounced nature have developed, particularly if the foreign body consists, as it usually does in this class, of a portion of a gum-elastic, waxed linen, or soft rubber catheter.

When a foreign body becomes lodged within the bladder, providing that it is too small, or is so located that its spontaneous expulsion is impossible, one of two things will occur : it will either form the nucleus of a calculous deposit, which will as a rule be phosphatic in character, or, by the pressure which it exercises upon the bladder wall, ulceration will be produced. In the latter case the subsequent course will be determined by the site of the ulceration. If it involve the peritonæum, the escape of urine within this serous cavity will give rise to rapidly fatal peritonitis. If the point of perforation be not such as to involve the peritoneal cavity, extravasation of urine in other directions will give rise to extensive septic cellulitis, sloughing of planes of connective tissue, putrid collections, and death by general infection and exhaustion.

Treatment.—When the patient is wise enough to acquaint the surgeon promptly with an explanation of the precise nature of the accident, suitable means may at once be employed for the removal of the foreign body. With the exception, however, of those cases in which the accident befalls those who are conscious of having employed the article lost within the bladder for a legitimate purpose (broken catheter, etc.), comparatively few will come under the surgeon's notice until acute evidences of ulceration and perforation manifest themselves, or symptoms simulating stone are present.

Probably the best instrument for the removal of a flexible catheter or a portion thereof from the bladder is a small, smooth-bladed lithotrite.

It is not necessary that the catheter be grasped by the end, for the reason that these instruments are so yielding, they will generally double up after once being grasped, and may be brought away with the exercise of moderately forcible traction. Where bougies of larger size, which have been used for purposes of dilatation, have slipped into the bladder, inasmuch as these do not possess the flexibility of hollow catheters, special instru-

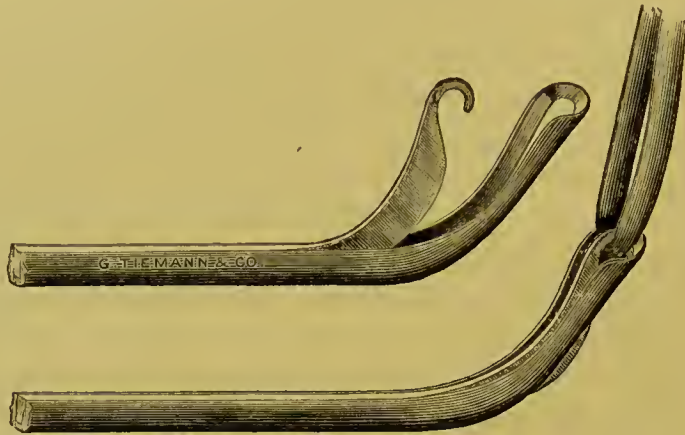


FIG. 1.—Mercier's duplicator.

ments may be employed for their extraction. Mercier has devised an instrument which may be employed for this purpose when the lithotrite fails. This instrument consists of a male and female blade, similar to those of a lithotrite. The female blade is half-tubular-shaped, and fenestrated near its beak; the male blade terminates in a hook-shaped extremity, directed downward, and fitting, when closed, into the fenestrum of the female blade.

In the rare cases in which it will come within the surgeon's opportunity to immediately remove a foreign body other than those just mentioned, the greatest circumspection is to be enjoined both in the selection of the means and the method of employing the same. While special instruments have been devised for the purpose of insuring a grasp upon inelastic cylindrical foreign bodies in the direction of their long axis, the surgeon must be prepared to meet these cases mainly by the exercise of his own ingenuity and the instruments to be found in an ordinarily well-equipped surgical armamentarium. The common lithotrite may be employed, with the patient in deep anæsthesia (and an anæsthetic is to be employed whenever practicable in these manipulations), in such a manner as to favor the extraction by the exercise of care and patience in grasping one of the extremities of the foreign body lightly, and "coaxing" it, so to speak, to the urethral opening. In this manner Reginald Harrison succeeded in extracting a lead-pencil three and a half inches long from the bladder of a male patient the day following its introduction.

Where the foreign body has produced ulceration and perforation of the bladder, the treatment must be based upon general principles and the conditions present in the case under notice. Should the case come under the surgeon's observation sufficiently early, even here prompt operative measures may meet with success. An immediate laparotomy, followed by cleansing the parts, their isolation by means of antiseptic gauze packing, thus providing means for drainage as well as favoring the formation of protecting adhesions, may, combined with perineal section, serve as a forlorn hope in cases of peritoneal perforation and extravasation, and is amply justified by the desperate straits in which a patient is placed by the occurrence of such an accident. In cases in which the foreign body lodges in such a fashion as to make pressure against the anterior vesical wall, the parietal and visceral layers of the peritonæum may become agglutinated sufficiently to protect the peritonæum, in which case the abdominal walls will become the scat of the urinary extravasation. In any case, extensive incisions promptly made along the lines in which the urine dissects up the connective-tissue planes are imperatively demanded, combined with efficiently maintained perineal drainage, antiseptic irrigation, either constantly maintained or frequently repeated, and absorbent dressings.

In cases in which a foreign body has remained in the bladder sufficiently long to become incrustated, the decision as to the best means to be employed for its removal must rest, in some measure, upon the character of the foreign body and the length of time since its introduction. While the use of the lithotrite, employed to crush and remove the calculous incrustation at a single sitting, may be the proper means in case the foreign body be small, or itself of a friable nature, in other cases it may be found that, while the perfect accomplishment of the crushing process as applied to the incrusting deposit will be all that could be desired on the one hand, on the other a lithotomy, either suprapubic or perineal, will be finally necessary for the purpose of removing the original cause. Therefore it would be but a wise precaution on the part of the surgeon, in a given case of vesical calculus with a history of a foreign body as the possible cause, to carefully consider this point, and, if the latter be a hair-pin, piece of wire, or other article in which the blades of the lithotrite may become entangled, to carefully weigh the propriety of performing one of the cutting operations as preliminary to its removal without delay.

The above remarks upon the treatment of foreign bodies in the bladder relate to cases occurring in the male. The female bladder is occasionally found to contain foreign bodies, of which perhaps hair-pins are the most common. Titillation of the region about the clitoris with these lead to their becoming engaged in and slipping from the grasp of the fingers along the urethra and into the bladder. They usually enter the

bladder with the bent portion first. This causes the free extremities to project forward within the bladder as two prongs, and enhances greatly the difficulties of their removal. This position of the pin may likewise produce ulceration and abscess.

In the removal of foreign bodies from the female bladder dilatation of the urethra will ordinarily suffice. Should this fail, the operation of cystotomy through the vesico-vaginal septum is to be preferred certainly to incision of the urethra, and probably to the suprapubic route. The resulting vesico-vaginal fistula, if primary union fail from any cause, can be subsequently dealt with in the usual manner.

III. MALFORMATIONS AND MALPOSITIONS OF THE BLADDER.

ABSENCE OF THE BLADDER.

Complete absence of the urinary bladder is of very rare occurrence. Instances have been observed of this anomaly, and in these the ureters, one or both, open either into the urethra, vagina, or rectum. Although permanent incontinence is the rule in the case of urethral implantation, yet it has occurred that the patients have lived to a ripe age with an entire absence of a proper bladder, one or both ureters, constricted at their lower portion and dilated, opening into the urethra and forming a reservoir for the accumulated urine. Post-mortem examination alone served to reveal the true state of affairs. It is probable that a certain amount of natural or spasmodic contraction at the point of constriction of the ureters in these cases prevents the occurrence of constant dribbling of urine, which otherwise must have occurred.

In complete absence of the bladder, efforts of an operative nature have not been thus far successful in ameliorating the sufferer's condition. Attempts have been made to divert the course of the urine by implanting the terminations of the ureters into adjacent portions of the intestinal canal in cases of exstrophy of the bladder, and no doubt these have been suggested by Nature's efforts in these cases of congenital absence of the bladder.

Tizzoni and Poggi have reported (Congress of Italian Surgeons, Bologna, April 16-18, 1889) a series of experiments upon dogs, made with the view of determining whether or not it would be possible to construct a urinary bladder from an isolated coil of small intestine. The design, in these experiments, was to replace the organ when removed in its entirety for disease. I am not aware that any attempts have been made to imitate these experiments, which met with a fair measure of success, upon the human subject, either in cases of extirpation of the bladder for malignant disease or in congenital absence of the organ.

MULTIPLE BLADDER.

Multiple, or, more properly speaking, divided bladder, has been described. These cases consist of the existence of a septum, dividing the bladder into two cavities. The division of the bladder into two or more cavities, as a result of disease, will be referred to in discussing the condition known as saeculated bladder. An instance of double bladder is referred to by Smith, of Baltimore, in which there likewise existed a double penis, with a separate urethra for each bladder. Blasius mentions a case in which five complete and distinct cavities or sacs existed.

These cases are of interest to the surgeon solely from the fact that calculous or other condition requiring interference may exist in one cavity, while the other may be healthy. The possibility of the existence of the malformation should be borne in mind in obscure cases. In Smith's case, one of the bladders contained a stone, for which a lithotomy was successfully performed.

CONGENITAL EXSTROPHY OF THE BLADDER.

In total fissure of the bladder the umbilicus is found either at the highest point thereof, or perhaps even upon a still higher plane in the cicatricial tissue; the edges of the vesical and abdominal fissures correspond exactly, and the symphysis pubis is also fissured. Assuming these facts, it is evident that this anomaly occurs somewhere about the second month of foetal life. It is at this period of intra-uterine life that the centers of ossification of the pubic symphysis are not yet established; the bladder reaches almost to the umbilicus, the abdominal wall is as yet membranous, and its muscular tissue has extended but a portion of the distance toward the median line. The foetus at this period is suspended by the umbilical cord, the latter lying upon the anterior abdominal wall, and, in cases in which, either from the greater development of the cephalic extremity of the body, or a more caudal insertion of the cord, the head hangs downward, and pressure is exerted, as the cord passes between the legs of the foetus, exactly at the point where both epispadias and ectopia vesicæ develop. The abundance of amniotic fluid will permit of the foetus assuming any position under the control of the force of gravity. By pressure the anterior abdominal wall is arrested in its development upon this line, and the intra-abdominal pressure eventually forces the posterior vesical wall into the fissure, where it presents its characteristic convex appearance (Rotgans). Whether the result of pressure of the cord, or from some other cause, the anterior wall of the foetal bladder is either destroyed, or fails of development entirely, and the mucous membrane of the posterior wall of the bladder unites with the abdominal plates in the line of the defect in the anterior wall, the condition becomes

ing that of a large fistulous communication between the bladder and external abdominal surface. The posterior wall and base of the bladder are normally developed.

The peculiar and characteristic appearances presented by a case of congenital exstrophy of the bladder are so striking as to scarcely be mistaken for any other condition. The posterior wall, thrown into rugæ by a reversal of its surface from a concave to a convex shape, presents itself at the line of fissure as a rounded prominence, dark red in color from being in a state of chronic hyperæmia. In some instances, particularly where care has not been taken to prevent undue pressure, the point of junction of the abdominal wall with the mucous membrane breaks down, granulations spring up, cicatrization takes place, and a ring of scar tissue, which gradually widens, operates to lessen the area of mucous surface. As time advances, this becomes more and more marked, until finally but a comparatively small area is left.

Upon the lower portion of the red, projecting surface the orifices of the ureters are found, through which urine flows intermittently, and a slender probe can, as a rule, be easily passed up to the pelvis of the kidney upon either side. Exceptionally the posterior bladder wall may present a concave instead of a convex surface anteriorly, in which case the orifices of the ureters are not so readily found (vesico-abdominal fissure without exstrophy).

As a rule, the fissure continues downward, involving the pubic symphysis and extending into the anterior urethral wall, thus dividing the two halves of the bilaterally developed genital organs of the male, in whom this condition is observed much more frequently than in the female. In the rarer instances in which it has been known to occur in the female, the posterior bladder wall ends in a short, open furrow, which corresponds in length to that of the female urethra. In the male, on the other hand, a long furrow, with its open part uppermost, passes along the dorsum of the stunted penis and through its glans. The prepuce itself is likewise divided, the two halves hanging downward upon either side of the furrow like a veil, and converting the normally short preputial frænum into a pendulous mass. The scrotum and testicles may be normal, or but illy developed. Large external inguinal herniæ are commonly observed in conjunction with this abnormality, which are probably due to the inherent weakness of the abdominal wall itself from loss of support at its median attachment. Cryptorchism, resulting from interference with the normal intra-abdominal pressure in its influence upon the descent of the testes, is almost a necessary accompaniment of the condition. Division of the scrotum into halves, whereby the parts somewhat resemble the labia majora, is sometimes observed. The pubic symphysis is never united; as a rule, the fingers can be placed between the undeveloped rami of the

pubic bones. The rectus abdominis muscle of either side may be partially developed; their separation, however, may continue for some distance above the upper limit of the abdominal fissure, the gap between the edges being bridged over merely by the integument. In cases in which this occurs ventral hernia is very apt to take place.

The miserable condition of patients the subject of this malformation is almost beyond conception. Excoriations of the surrounding parts, and chronic dermatitis from the presence of decomposing urine, giving rise to itching and burning almost beyond toleration, together with the constant presence of a urinous odor in the clothing, combine to exclude the individual from society, and to render life a burden to him. This is particularly true of those in the lower walks of life, in whom the wearing of expensive apparatus, consisting of an accurately fitting rubber funnel and receiver, and frequent changes of clothing, are well-nigh impossibilities.

Treatment.—The resources of operative surgery have been taxed to their utmost in behalf of this class of sufferers, and many operative procedures have been devised for the relief of the disgusting and wretched state in which they are plunged. These all have for their object the closing in of the abdominal wall in such a manner as to replace the absent anterior vesical wall. To these efforts have been added those designed to form a urethra from the furrow upon the dorsum of the penis. To accomplish the first named, the operation designed and carried out by the late Dr. Daniel Ayres, of Brooklyn, N. Y., has proved thus far, in the hands of the writer, the most successful. It consists essentially of taking a flap of skin from the abdominal wall above the fissure sufficiently long and wide, when allowance is made for its contraction, as to cover completely the defect. The hinge upon which the flap turns as it is reversed and laid with its integumentary surface facing the posterior bladder wall, and its raw surface presenting anteriorly, corresponds to the limit of the upper rounded edge of the fissure. Two lateral flaps are now dissected up, their free margins corresponding to the edges of the defect upon side. By a sliding movement these free edges are made to approximate each other in the median line of the body, and over the raw surface of the flap which has been turned from above downward. In this manner each lateral flap covers the corresponding half of the first flap, and an anterior bladder wall, representing in thickness double that of the integument itself, is formed. These flaps are sutured in position by means of silk-worm gut (*crin de Florence*) rather than silk, for the reason that this material is less likely, during the time when its presence is necessary, to absorb urine and become the site of deposits of the urinary salts, thus increasing the irritation and lessening the chances of union. An opening is left at the root of the penis for the escape of urine in instances in which no effort is made to restore the urethra.

Where it is decided to attempt the relief of the epispadias as well, the operation of Thiersch, of Leipsic, answers the purpose better than any other. A new track for the passage of urine, extending from the base of the bladder and passing in front of or through the soft structures, marking the site of the pubic symphysis, and thence to the perinæum, may or may not be required preliminarily. If this additional precaution is made use of, there should be passed through this channel a soft-rubber tube, having a eup-shaped flange resting against the bladder wall, to collect and guide the flow of urine away from the base of the penis. This being accomplished, the furrow upon the dorsum of the penis is deepened by a longitudinal cut extending its entire length. A strip of surface is now denuded upon either side of the penis; by approximating these latter and securing them by sutures in position, a soft catheter of proper size occupying the furrow deepened by the above-mentioned incision in its bottom, a covered channel for the transmission of the urine from the bladder is formed.

The flanged catheter should be retained in the artificial urethra opening into the perinæum until the new channel upon the dorsum of the penis is formed. When this is completed the former is to be allowed to heal. In the operation for formation of an anterior bladder wall a permanent catheter should be kept in place in the completed urethral channel upon the dorsum of the penis until the completion of the healing process.

In thus furnishing a flap from the abdominal wall for the purpose of supplying a defect in the vesical wall, it is expected that the integumentary surface thus reversed and made to take the place of mucous membrane would take on more or less of the characteristics of the latter. To what extent this occurs is thus far problematical. In one case upon which the writer operated, in the Methodist Episcopal Hospital in Brooklyn, the child was brought back to the hospital in about eight months after the operation, suffering from a violent rectal tenesmus, the cause of which was found to reside in a formation of calculous material upon the artificially formed anterior wall. This was removed by means of a small uretete introduced through an opening made for the purpose at the base of the penis and alongside of the vesical opening of the artificial penile urethra. This opening healed in a few weeks.

After all, the hope of benefit to be derived from these operations is solely that an apparatus may be worn to catch the urine with greater facility. There must of necessity be incontinence, for nothing has as yet been devised to take the place of the sphincter vesicæ. This, and the advantage to be derived from relieving from irritation and pressure the theretofore unprotected posterior vesical wall, constitute the sole justification for their performance.

CONGENITAL DEFECTS OF THE POSTERIOR BLADDER WALL.

Congenital defects of the vesico-vaginal and vesico-rectal septum have been observed, the condition varying from a complete absence of the septum to the existence of a mere fistulous communication. In the case in the first named the condition is almost necessarily a hopeless one. Where a fistulous communication exists, operative measures of a plastic nature may with propriety be instituted.

PATENT URACHUS.

A further abnormality of the bladder, congenital in character, consists of a persistency of the cavity of the urachus, this apparently resulting from some obstruction to the free passage of the urine by the normal channel. Early in intra-uterine life the intra- and extra-abdominal portions of the sac of the allantois communicate with each other through the umbilicus. Coincidentally with the disappearance of the extra-abdominal portion of the sac the lower half of the intra-abdominal portion becomes the urinary bladder, while the upper half later on (at or about the seventh month) becomes impervious, and connected with a fibrous cord extending from the summit of the bladder to the umbilicus. This fibrous cord, known as the urachus, may fail of complete obliteration, and form a fistulous communication between the navel and the cavity of the bladder. This constitutes the more common form of the affection, and its existence is announced by the occurrence of a discharge of urine from the umbilicus. Calculous concretions may form along this abnormal urinary tract, and inflammatory conditions as well as suppuration occur.

The most aggravated form of this condition consists of a complete prolapse of the vesical wall through the urachus, as observed by Von Gusseron and Froriep. Generally speaking, this form presents itself as a portion of mucous membrane, of the size of a cherry, from some point of which urine is seen to flow from an opening. This is found to be irreducible.

Treatment.—In the treatment of this class of cases the first care must be to insure complete and uninterrupted patency of the normal urinary passages. To accomplish this in the female, it has been recommended to produce artificial incontinence by forcible dilatation of the entire urethral tract. In the male the bladder may be placed entirely in a state of rest by tube-drainage through the perinæum. This being accomplished, the means employed to close fistulæ in general may be resorted to, such as the application of the actual cautery, the performance of plastic operations, etc.

HERNIA OF THE BLADDER.

Cystocle in the male occurs most frequently in the inguinal canal. It may be found as a complication of intestinal hernia in this region, or

the entire protrusion may consist of the bladder alone. In either case it may be complete or incomplete, and occupy simply the inguinal canal or extend into the scrotum. In those instances in which cystocele is found as a complication of intestinal hernia the bladder, as a rule, will be found lying behind the intestine. In uncomplicated cases the protrusion is destitute of a sac for the greater part of its extent, owing to the fact that the bladder is normally only partially covered by peritonæum.

The importance to be attached to the condition under consideration is due mainly to the fact of its comparative rarity, and the dangers to which a patient suffering from hernia of the bladder may be exposed, from an error of diagnosis. It usually presents itself as a rather soft and fluctuating tumor with some elasticity. The especial point to be borne in mind is the fact that it varies in size at different times, that it is capable of being emptied by pressure, and that this emptying of the sac is at once

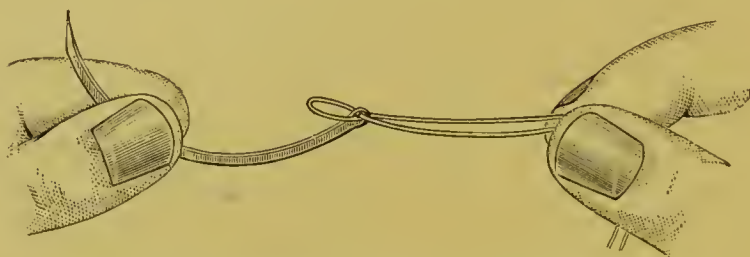


FIG. 2.—The crossed suture. Manner of threading the needle.

followed by a desire to urinate. Indeed, it may happen, as is sometimes found in females suffering from vaginal cystocele, that the act of micturition can not be accomplished without first raising the tumor and other-

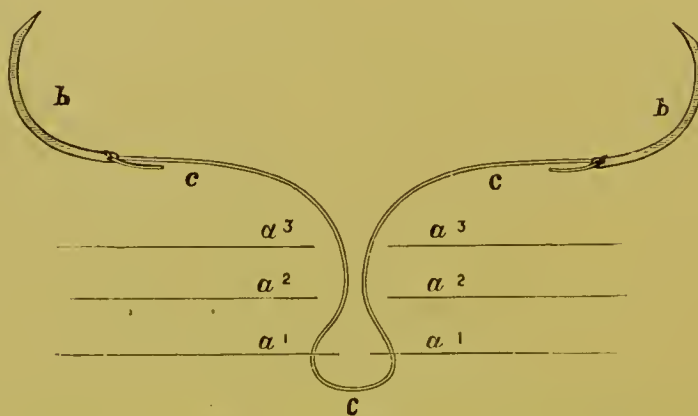


FIG. 3.—The crossed suture. Showing suture passed through lowermost layer. a^1 , first layer; a^2 , second layer; a^3 , third layer.

wise manipulating it. In some respects it may resemble hydrocele of the cord; and no less an authority than Pott relates an instance in which, under the supposition that he was dealing with a diseased testicle, he

incised a cystocele which had found its way into the scrotum. It is more likely to be mistaken for hydrocele of the tunica vaginalis testis, in

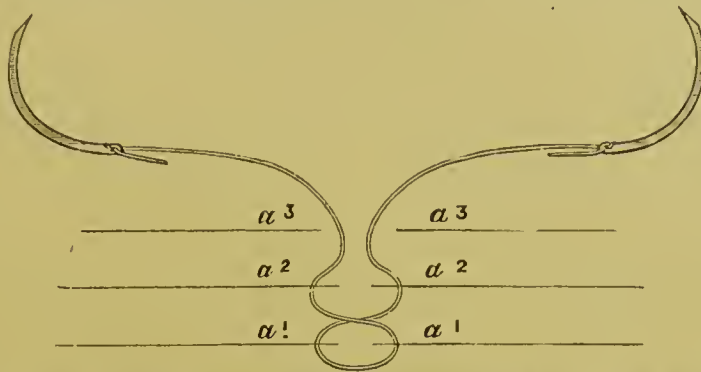


FIG. 4.—The crossed suture. Showing suture crossed and passed through second layer from below upward.

which case the operation of tapping would expose the patient to grave dangers.

The complications to which hernia of the bladder may give rise relate mainly to—first, retention of urine ; second, cystitis ; third, calculous dis-

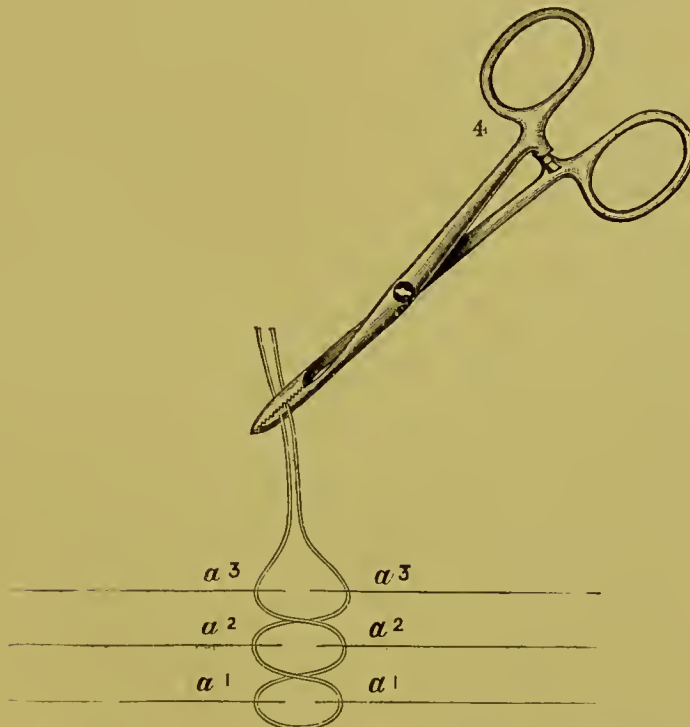


FIG. 5.—The crossed suture. Showing all three layers included in the suture ready for tying. 4, ordinary hæmostatic forceps, temporarily securing suture for ready identification until all are ready for tying.

ease. The herniated bladder must very rarely become strangulated ; at least I am not aware of a recorded instance of the occurrence of this accident. Angulation of the sac may give rise to partial or complete

retention of the contents, but patients, as a rule, instinctively take care of this by manipulation; hence the surgeon's services are rarely called into requisition because of this complication.

Treatment.—In the treatment of the displacement under discussion, the same principles should govern the surgeon as are applicable to other forms of hernia. Both palliative and radical measures may be called for in different cases. In the former are to be included the use of trusses or other supports. These should be carefully adjusted to the position, nature, and extent of the protrusion. It may occur that, in spite of the most carefully fitted apparatus, the hernial protrusion exhibits a marked tendency to pass beyond the limits of the inguinal canal, and to extend into the scrotum. This circumstance, combined or not with the occurrence of angulation and consequent retention, will be sufficient to justify the surgeon in recommending the operation for radical cure. In fact, so favorable are the statistics of the present day in radical herniotomy that it is a question if all instances may not with propriety be at least offered the opportunity for radical cure.

In selecting the means of bringing about a radical cure, the surgeon will be guided more or less by his preferences for operative procedures intended to cure intestinal hernia; they are to be dealt with identically. In the present state of our knowledge, it is probable that the procedure known as Potemski's modification of Bassini's operation offers the best chance of permanently relieving the patient. This consists essentially in reducing the herniated portion, after exposing the same by the usual incision parallel to Poupart's ligament, lifting the spermatic cord from the inguinal canal and carrying the same toward the median line, and attaching it to the external oblique muscle, this having been previously bared for that purpose. The cord is here held in position by a *loose* suture of catgut. The margins of the inguinal groove, as it now becomes, are drawn together, including the arched fibers of the transversalis muscle at the internal ring, leaving but just barely room in the latter for the passage of the spermatic cord. It may be mentioned here that the latter, as it leaves the internal ring, should take a direction first upward and inward for an inch or more, prior to being attached to the external oblique. For the purpose of suturing the canal and ring, chromic gut as a buried suture may be employed; preference may be given, however, to the method known as "cross-suturing." This consists in including the different layers, from below upward, in loops of silk-worm gut, arranged in figure-of-eight fashion (Figs. 2, 3, 4, 5). The advantage of this method consists in the fact that one by this means may employ a suture which will serve to accurately coaptate the individual layers and yet be capable of removal at will (Annals of Surgery, May, 1892, page 351). These should be allowed to remain for at least fourteen days; it is

my habit to remove them between the fourteenth and twenty-first days. The entire procedure should be conducted with due regard to aseptic conditions, in which case no drainage should be employed.

Hernia of the bladder occurring in the female, or vaginal eystocele, is usually treated by the gynæcologist; the reader is therefore referred to works upon the diseases of women for the discussion of this condition.

INVERSION OF THE BLADDER.

The condition known by this term is of exceeding rarity, and is only found in females. As its name implies, the viscus is literally turned inside out, and projects as a red, polypoid mass from the urethra. The inversion is, as a rule, but partial, and may be complicated, as in the case of a sixteen-months-old child observed by Ashhurst, with prolapse of the rectum.

The diagnosis of this affection is important. The error may be committed of attempting its removal, under the belief that a polypoid tumor is present. The points to be observed are as follows: Presence of a pyriform, red, vascular elastic tumor between the labia, below the clitoris, and above the vaginal orifice; the urethra is not discoverable, and careful inspection will reveal in the mass the orifice of the ureters with urine issuing therefrom, if the inversion be sufficiently complete. As considerable relaxation of the urethral orifices must have been previously present, a history of incontinence preceding the inversion will usually be obtained, and the first appearance of the tumor following a violent expressive effort at micturition or defecation.

As a complication of this condition, rupture of the inverted bladder has been recorded. The case was under the care of Mr. Croft, and it appears from the description that the inverted and ruptured viscus was returned under chloroform. The patient made a complete and permanent recovery.

The treatment of inverted bladder consists in a reduction of the viscus, and care on the part of the patient to guard against a relapse. Should this occur, scoring the parts about the vesical neck with the actual cautery before reduction, in order to favor increased solidity and hence support of the relaxed parts, has been recommended. In a persistent case, laparotomy and intraperitoneal fixation would be justifiable as a last resort.

IV. OTHER ABNORMITIES OF THE BLADDER.

HYPERTROPHY OF THE BLADDER.

Hypertrophy of this organ is a symptomatic and never an idiopathic condition, and is to be regarded as the natural result of obstruction to

micturition, or any condition which persistently stimulates the muscular wall into contraction. Thus, inflammatory changes in the bladder of both acute and chronic character, especially the latter, by giving rise to greater frequency of micturition, and in obstructive conditions of any portion of its outlet, by giving rise to proportionate development in order to make provision for the additional resistance which must be overcome, increase the nutrition of the muscular structure until the latter attains many times its natural bulk.

Muscular hypertrophy may be *eccentric* or *concentric*, the first named being attended by general dilatation of the organ, and results from obstructive conditions of the outlet; while the latter is rather marked by a contracted condition, and is the natural consequence of causes which tease the organ into frequent use of its muscular apparatus, such as the presence of foreign bodies, calculus, etc. Chronic cystitis is the most frequent cause of the last-named condition, and it is commonly designated *contracted bladder*.

In the eccentric form of hypertrophy there sometimes occur herniæ of the mucous membrane and subcutaneous cellular tissue through adjoining portions of the muscular fasciculi. Thus pouches are formed, and in these sacs or diverticula urine is apt to collect and be retained; this, by undergoing decomposition, produces by its presence irritation and inflammation.

The prognosis depends, as a rule, upon the curability of the condition which gives rise to the hypertrophy. In the form resulting from obstruction, when the latter is removed the hypertrophy generally disappears. Occasionally, however, it happens that a condition of irritability remains, due probably to the presence of diverticula long after the structure has been sufficiently relieved to no longer act as an obstruction.

Treatment.—Being simply an effect of disease, the treatment of this condition relates almost entirely upon the removal of the primary or determining cause upon which it depends. The exception to this is to be noted in the cases in which, after removal of the obstructing cause, irritability of the bladder and more or less persistence of the hypertrophy remain. Here cystotomy and irrigation are indicated, and have been resorted to with beneficial results. This procedure exerts a favorable influence in two ways: In the first place, perfect rest is given to the organ for several weeks, under the influence of which the increased muscularity diminishes or comparative atrophy ensues. In addition, residual urine undergoing decomposition is prevented, and lessened irritation and consequently lessened frequency of expulsive effort follow.

Limited hypertrophy will be described under the head of Bar at Neck of Bladder.

ATROPHY OF THE BLADDER.

This condition of the bladder is but rarely met with save in aged persons who are thin and emaciated, and in certain cases of paralysis from defective nutrition, although both Hunter and Bonnet have recorded cases of rupture of the bladder, even in young subjects, by simple pressure over the organ during catheterization. In cases in which the organ has been greatly over-distended, fatty degeneration may take place and atrophy ensue. So, also, atrophy may occur as a result of malformation or extensive vesical fistula, the bladder ceasing to perform its function, and being reduced to a rudimentary state.

SACCULATED BLADDER.

This condition has already been referred to as one of the results of eccentric hypertrophy of the bladder. It is most commonly observed in connection with the hypertrophy due to prostatic enlargement, and occurs as pouches or diverticula, which protrude between separated portions of the muscular coat where the mucous membrane is unsupported. In these, urine lodges and may undergo decomposition. Under the influence of expulsive efforts on the part of the bladder the pouches tend to become constantly deeper, until they at last attain a capacity of several ounces.

Among the inconveniences incident to sacculated bladder, aside from those already mentioned, is to be noted the fact that these pouches may become the receptacles of calculous material. Instances have been recorded in which the lethal result following lithotomy has been attributed to the fact that sharp fragments, following the operation, have lodged in these diverticula and given rise to severe and fatal cystitis.

Diagnosis.—The diagnosis of this condition is not easily made. It may be suspected to exist if, upon introducing a catheter for the purpose of emptying the bladder, it is found that a still further flow can be obtained by changing the position of the patient, or raising him from the recumbent to the upright position. It sometimes happens that the bladder is injected with a measured quantity for purposes of examination, and, upon permitting the organ to empty itself, but a relatively small quantity is expelled. This will lead at once to a suspicion that sacculation exists. The employment of a silver catheter, the beak of which can be rotated into different positions, may lead to the withdrawal of urine or injected fluid containing puriform material from the pouches. This varying of the appearances of the urine during different stages of the flow is held by Cadge to be a diagnostic, although not pathognomic, sign.

The results of sacculation, in addition to the aggravation of cystitis, which already exists, and the impaction of calculi, relate first to the possi-

bility of an enormous tumor rising into the abdominal cavity and giving rise to erroneous operative interference and, in case of the involvement of the posterior wall, suppuration of the sacculus. In the last-named condition an abscess, which finally communicates with the rectum, occurs as a consequence, with recto-vesical fistula and the passage of fecal matter into the bladder.

Treatment.—In the treatment of sacculated bladder attention should be paid to the subject of drainage and cleansing of the viscus by irrigation following the removal of the cause. If this condition is suspected, complicating a calculus, the latter had better be removed by one of the cutting operations, unless there be some positive contra-indication, and drainage and irrigation practiced until the muscular apparatus is restored to its normal state.

BAR AT NECK OF BLADDER.

This term has been applied by English and French authorities to a condition believed to occur independently of prostatic enlargement, but usually associated with the latter, and which by its presence gives rise to more or less obstruction to the free performance of the act of micturition. Three varieties of the affection are recognized and described by Mr. Reginald Harrison, namely, (1) spasmodic, (2) mucous, and (3) muscular.

The first or *spasmodic* variety is found chiefly to exist in persons of a gouty or rheumatic disposition, who possess in a high degree the uric-acid diathesis. It appears to consist of an irregular or spasmodic action of the muscles at the vesical neck during the action of micturition, and is not in any sense due to prostatic involvement, inasmuch as it is frequently found where no hypertrophy is present. Delafosse describes it as a contracture of the vesical neck. It is questionable if the condition so described should be considered as a "bar" at all in connection with permanent structural changes at the neck producing obstruction to urination.

The treatment of contracture of the vesical neck or "stammering of the bladder" (Paget) is in the main purely medicinal. The diathesis upon which its production depends requires especial attention, and the remedies to be employed will include those usually found useful in gouty or rheumatic conditions. It has been thought that the symptoms depend in some measure upon extreme sensitiveness of the prostatic urethra; hence the recommendation by some authorities that a solution of nitrate of silver, two grains to the ounce, be employed, applied occasionally to this part by means of a deep urethral syringe, after a thorough anti-rheumatic course.

The second or mucous variety is formed, as its name implies, from a more or less distinctly formed duplicature of the mucous membrane, and has always been found to be associated with and dependent upon prostatic

hypertrophy. This variety appears to result from lateral enlargement of the prostate, and the "buckling" up, so to speak, of the floor of the urethra. It is crescentic in shape generally, and may even form a distinct valve-shaped flap at the vesical urethral orifice. The extent of the mucous bar does not necessarily depend upon the amount of lateral hypertrophy present; a certain extent of elevation of the mucous membrane, called the *uvula vesicæ*, is found at this point in health. The introduction of a sound will reveal a distinct "catch" as its point slips over the bar, while conjoined manipulation with the finger in the rectum simultaneously will show that the distance between the sound and the finger is but slightly increased beyond the normal. Careful examination, however, will reveal more or less increase in the normal lateral boundaries of the prostate.

The third or muscular variety, sometimes known as the limited hypertrophy of Guthrie, always exists in connection with prostatic enlargement, although structurally it is not connected with the prostate. Here a bar is formed at the neck of the bladder by the excessive development of some of the muscular fibers which run transversely across the trigone behind the prostate, thereby forming a more or less prominently marked elevation, and dividing the bladder at this point into two separate and distinct compartments, an upper and a lower one.

The explanation given by Reginald Harrison of the occurrence of limited hypertrophy of the bladder at the trigone, or muscular bar, is probably the correct one. This eminent authority says that the formation or aggregation of muscular tissue at this point is due to a conservative effort on the part of Nature to empty the pouch which forms at the trigone and the posterior limit of the prostate in cases of enlargement of the latter, and in which urine tends to collect.

As in the case of sacculated bladder, the diagnosis of the condition is attended with marked difficulty. Nor is its differentiation of great importance, so far as the usually employed treatment of impeded micturition in elderly persons is concerned. The treatment of muscular bar is the treatment of the enlarged prostate upon which it depends, for the details of which the reader is referred to the chapter upon injuries and diseases of that organ.

SUPRAPUBIC VESICAL PUNCTURE IN OBSTRUCTIVE DISEASE AT THE VESICAL NECK.

This operation is indicated as soon as catheterization can not be accomplished, and simultaneously decided retention of urine is at hand. These circumstances will usually co-exist, for the reason that the abnormal condition which interferes with the passage of the catheter likewise operates more or less completely in preventing micturition. The course of re-

tention, due to prostatic obstruction, may vary considerably, in some instances the retained urine accumulating rapidly, the vertex of the bladder reaching above the umbilicus within twenty-four hours. On the other hand, it may require weeks to reach this condition in cases in which the patient occasionally passes small quantities of urine. The urgency, therefore, of the demand for the performance of the operation will depend upon these varying circumstances. In any event, the patient should not be permitted to suffer where retention, whether complete, as in the first named, or incomplete, exists. The mere fact that the bladder is over-distended, and no catheter can be passed, is sufficient justification for the performance of an operation so devoid of risk in proper hands.

FISSURE OF THE NECK OF THE BLADDER.

This condition, analogous in some respects to anal fissure, although much smaller, is of comparative rarity in the male. It is most frequently met with in females, in whom it is properly termed *vesico-urethral fissure*. It is only within the last few years that this condition has been brought to the notice of the profession.

In the male the symptoms are such as to suggest the variety of spasmodic bar at the neck of bladder, or *contracture du col vésical* of the French. There is the same frequency of micturition, with a hesitancy, so to speak, during the act. There are these differences to be noted, however: whereas, in spasmodic bar, the "stammering" is more particularly noted in the commencement or middle of the act, in fissure the sensation is often described as an alternate opening and closing at the end of the act, accompanied by the presence of a few drops of blood following the last of the urine, and a sharp, stinging pain, referred to the neck of the bladder. In varying degrees of acidity of the urine the pain in the same individual may vary, becoming more intense as the acidity increases, and lessening in severity when the urine becomes neutral or alkaline in reaction. The passage of an instrument into the bladder occasions great distress, and pressure against the vesical neck from the rectum similarly produces pain at this point.

In females the symptoms are such as to suggest cystitis. There is a feeling of burning at the neck of the bladder, and acute pain during and following the act of micturition and vesical tenesmus. These symptoms continue for some time, finally subsiding, only to recur as soon as urine collects in the bladder. In differentiating, however, it is to be noted that in cystitis the pain is never localized, and the act of urination is followed by a sense of relief, while in fissure the reverse is true. In females particularly the endoscope will be found useful in making the diagnosis.

The treatment consists in producing and maintaining a neutral or alkaline condition of the urine, combined with the local application of a

solution of nitrate of silver, one grain to the ounce, to the prostatic urethra. In the female, by means of Skene's fenestrated endoscopic tube with closed end, it is possible to touch the fissure directly with the modified nitrate-of-silver stick. Should this means fail after a few applications, the urethra should be dilated after Simon's method, and a condition

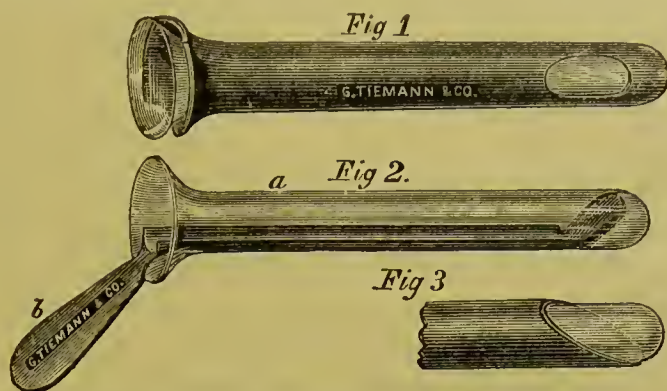


FIG. 6.—Skene's endoscope, for the female urethra.

of temporary incontinence produced. Cases persistent in character and otherwise intractable in the male should be subjected to cystotomy, preferably by perineal section. The object of these operative procedures is to obtain complete rest for the region about the neck of the bladder. The suffering produced by vesical fissure may be so great as to demand immediate relief by cystotomy.

V. PUNCTURE OF THE BLADDER.

In opening the bladder for any purpose, advantage is taken of its but partial serous investment in order to avoid risks incident to section of the peritonæum. With this in view, the following routes have been devised: (1) above the pubis, (2) by Voilemier's sub-pubic operation, (3) through the symphysis, (4) from the perinæum, and (5) from the rectum.

Suprapubic Puncture.—By all odds the best method of performing vesical puncture is by the suprapubic route. The interior of the bladder may be reached in this way through the space immediately above the pubic bone without wounding the peritonæum. As shown by the researches of Ponliot, Bernays, and others, this space varies greatly in extent in different individuals, although it is always increased in distention of the viscus. It is well, however, to keep as close to the parts as possible, with the patient in the horizontal position. A general anaesthetic is not required, as the introduction of the trocar occupies but a few seconds, and the rest of the operation is painless. The suprapubic region should be shaved and thoroughly cleansed beforehand. A slight skin incision may be made prior to the introduction of the trocar, but, as a rule,

when the aspirating needle is employed this may be omitted. When it is tolerably certain that the operation is to be required but temporarily, and the hope is entertained that the natural channel will shortly be re established, the aspirator will be found the most useful instrument. The point of the index-finger should be placed so as to mark the site of the upper limit of the pelvic arch, and by a quick, thrusting movement the aspirator needle, attached preferably to a previously exhausted bottle, made to penetrate to the interior of the bladder. If it is designed to accomplish a more permanent drainage of the bladder, a curved trocar and cannula are selected, and under cocaine anæsthesia a small incision made. This is rendered necessary particularly in fat individuals, and should extend to the muscular layer, to avoid the recession of the abdominal walls before the larger-sized and curved trocar, the passage of which is resisted by the former. The index-finger of the right hand should be placed upon the instrument at the point to which it is intended to introduce it, thus varying in different cases according to the thickness of the abdominal wall. The convexity of the curve should be placed in an upward direction, the concavity of the instrument hugging the posterior surface of the symphysis pubis, thus the more effectually guarding against injury to the peritonæum.

It sometimes happens, whether the aspirating needle or cannula is employed, that blood-clots, resulting from previous attempts at catheterization, obstruct the free flow of the urine. In this event the introduction of a clearing wire into the former, or the trocar into the latter, is necessary. If the outflow is frequently embarrassed in this way, a solution of boric acid, or borate of soda, should be forced repeatedly through the instrument, and the coagulation broken up gradually in this way.

When the incision is employed, care is to be taken that the urine, which under these circumstances is usually decomposed, does not produce infection of the abdominal walls by coming in contact with the wound surfaces. In order to avoid this, pledgets of cotton or gauze, saturated with a 1 to 1,000 mercuric-chloride solution, should be wrapped about the cannula after its introduction and packed into the wound, or a stream of the same solution is to be allowed to run over the parts during the evacuation of the bladder contents. When the aspirating needle is employed, its withdrawal should not be attempted until the bladder is empty, and then only with the inlet stop-cock open, and as complete a vacuum as possible present in the aspirating bottle. By this means infection of the abdominal walls is avoided. A simple strip of adhesive plaster sterilized by being heated, covered with a pledget of cotton saturated with mercuric-chloride solution, suffices as a dressing.

If aspiration has been employed, the bladder need not be washed out at this time, but this may be postponed until the viscus can be reached by

the natural route. If the larger trocar and cannula have been employed, a soft-rubber catheter may be passed through the latter, and irrigation performed by means of Thiersch's boro-salicylic solution. The cannula may be fastened in place by means of tapes passed through openings in its flange, somewhat in the manner employed in securing a tracheotomy-tube. Either an antiseptic dressing may be placed over the tube, or Dittel's suggestion followed. The latter consists in attaching a rubber siphon-tube to the cannula, and leading it to a receptacle in which an antiseptic solution is placed. Either of these procedures is to be preferred to the old plan of placing a small cork or ball of wax in the cannula outlet, and removing this occasionally to empty the bladder. Urinary infiltration is almost certain to follow the adoption of this method.

In the after-treatment of cases of suprapubic puncture, where a cannula is to remain for a time, the points to be borne in mind relate particularly to, first, the maintenance of a strictly antiseptic regimen; and, second, to the prevention of irritation from the presence of the cannula and the deposit thereon of the urinary salts. The first named is accomplished by several times daily irrigation of the bladder with the boro-salicylic solution, and an occasional mercuric-chloride solution when the urine is very fetid, in addition. The latter need not be employed stronger than a 1 to 4,000 solution. In order to remove and replace the cannula easily, the following expedient may be resorted to: An elastic catheter is to be passed through the cannula and into the bladder, where it is held while the latter is withdrawn. After cleansing, the cannula is to be replaced by slipping it over the catheter, using the latter as a guide. After the lapse of a fortnight the wound is converted into a granulating track, and the use of the catheter may be dispensed with.

The permanent withdrawal of the cannula depends upon the course of the individual case. It is a frequently observed fact that a very decided and sometimes rapid subsidence of the swollen prostate follows puncture of the bladder. In instances, therefore, in which the operation is performed for retention due to this cause, the introduction of the catheter by the normal route is possible sooner or later. The cannula should not be permanently withdrawn until this is fully assured, and in cases in which false passages have resulted from previous attempts at catheterization, this should be postponed until their closure is believed to have taken place. Upon the fifth or sixth day the catheter may be passed, if this can be accomplished, and repeated upon several subsequent days; drainage by the cannula may then be abandoned. The granulating canal closes very quickly, cicatrization occurring in twelve hours in some cases. The further management of the case will then depend upon the measures selected for the amelioration or cure of the condition producing the obstruction.

Suprapubic puncture has been employed for the purpose of accomplishing posterior catheterization (Brainerd), and for the locating of an impermeable stricture in instances in which, owing to the presence of false passages, this can not be done with certainty from in front. A metallic catheter, passed through the suprapubic puncture and into the internal urethral orifice, will frequently accomplish the above-named purpose in a very satisfactory manner, and permit a safe and easy external urethrotomy, the catheter serving as a guide. The same manoeuvre may be executed in cases of rupture of the urethra, the presence of the catheter passed from behind enabling the operator to identify the central end of the torn urethra after perineal section, therefore avoiding a long and tedious and sometimes fruitless search. When suprapubic puncture is performed for this purpose care should be taken to select a cannula whose curve corresponds to that of the catheter or guide intended to be employed, otherwise some difficulty may be encountered in manipulating the latter.

When aspiration is employed (and this method is to be given a fair trial before the employment of the permanent cannula), the operation may be repeated, if necessary, two or more times daily for several days; the bladder should not be allowed to become over-distended after the first aspiration, for the reason that urinary infiltration may take place along the needle-track, under these circumstances.

Subpubic Operation.—Voillemier's proposal to puncture the bladder below the symphysis has attracted some attention. The advantages claimed for this method are, first, that the adhesions between the anterior vesical wall and the abdominal wall which may follow the suprapubic method are avoided; and, second, that the bladder is opened at a lower point, and is thus emptied more readily. In carrying out this procedure the penis is drawn strongly downward, and the trocar and cannula passed through the skin and middle pubo-prostatic ligament or deep femoral fascia, which fills the angle formed by the descending rami of the os pubis. The method has never become popular, for the reason that its alleged advantages are more than counterbalanced by the uncertainty of reaching the bladder, owing to the fact that its base is distended the least relatively in retention; and further, by the danger of injuring the dorsal artery and vein. The operation is not easy of performance, and the position of the opening is neither a convenient nor a comfortable one.

Puncture through the Symphysis Pubis.—Puncture of the bladder through the symphysis pubis has been recommended (Brainerd). This, like the preceding, has no advantage over the suprapubic method, and is open to the objection that it may, in aged persons, be exceedingly difficult of performance, because of ossification of the intra-

pubic cartilage. Under such circumstances, as suggested by Coulsen, it would be necessary, in order to carry out the procedure, to perforate the ossified cartilage by means of a bone-drill.

Perineal Puncture.—Tapping the bladder from the perinæum (Cock's operation) is particularly adapted to cases of irremediable stricture of the urethra, complicated with urinary fistulæ, and a perinæum more or less disorganized by inflammatory exudation, and in which but a remote prospect exists of establishing the continuity of the natural passage following the relief of the retention. The cases are but comparatively few at the present day in which this procedure will become necessary, perineal section, the structures being divided layer by layer, with attempts at the restoration of the urethra to a useful condition, having taken its place (see external perineal urethrotomy). This is to be preferred to the method originally suggested by Cock, which consisted in plunging a knife through the perinæum, at the apex of the prostate, along the prostatic urethra and into the bladder.

Direct perineal paracentesis—or Reginald Harrison's operation—is adapted to cases in which the obstruction to micturition has its origin in the prostate itself, and is behind the point at which the urethra is tapped in Cock's operation, as well as in the ordinary perineal section. It consists of puncturing the bladder directly through the prostate from the perinæum, without reference to the line of the urethra. The operation is performed as follows: With the left index-finger in the rectum as a guide, a trocar (see Fig. 7), specially made for the purpose, is introduced into the median line of the perinæum about three fourths of an inch in front of the anal margin, and pushed steadily through the prostate into the bladder. The trocar is now withdrawn, and the cannular portion of the instrument retained in position by suitable tapes attached to its

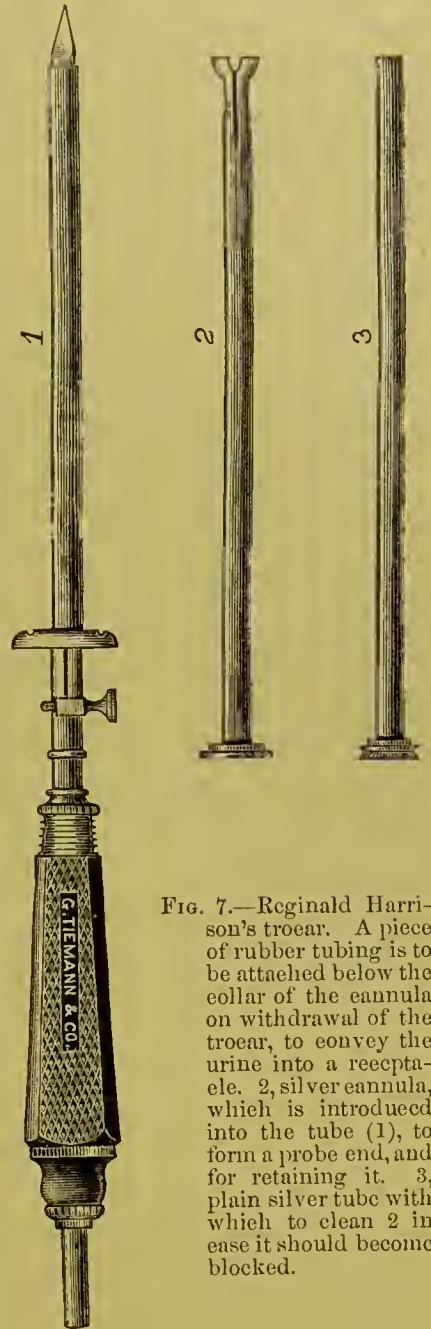


FIG. 7.—Reginald Harrison's trocar. A piece of rubber tubing is to be attached below the collar of the cannula on withdrawal of the trocar, to convey the urine into a receptacle. 2, silver cannula, which is introduced into the tube (1), to form a probe end, and for retaining it. 3, plain silver tube with which to clean 2 in case it should become blocked.

shield or flange. In one remarkable case narrated by Harrison, the first in which the method was employed, the patient, a man of eighty-four, not only was made comfortable by the operation, but in the course of the following two months the prostatic enlargement almost entirely disappeared, and the tube was withdrawn.

The advantages claimed for this method by Harrison are, first, a convenient position for the external opening in all positions of the body; and, second, the establishing of a short, low-level urethra, adapted to the altered relations of the urethra and prostate when the latter becomes enlarged, for the purpose of securing the most perfect drainage. The operation need not be limited in its application to cases of retention. It may be employed in cases in which a condition of constant vesical irritability and inflammation render it necessary to establish a permanent opening. Under these circumstances Harrison suggests that a sound should first be passed into the bladder and its beak reversed in such a manner as to lie in the depression behind the prostate. The point of the trocar should be directed against this.

Puncture from the Rectum.—Tapping the bladder from the rectum, first introduced by Fleurant, is but rarely practiced at the present day. The left forefinger is introduced into the rectum and the bulging posterior wall of the bladder identified beyond the prostate. Into this, precisely in the median line, the trocar is to be thrust. The objections to this operation are as follows: There is great difficulty in securing the cannula in position; the latter interferes with defecation, and it is almost impossible to replace it after it has been accidentally displaced. As a temporary expedient it is unnecessary, and as a permanent means for supplanting the normal channel it is comparatively useless, or at the best exceedingly difficult of management. In addition, it is not devoid of danger. Hill makes the observation that injury to the recto-vesical fold of the peritonæum in the *cul-de-sac* of Douglas has followed rectal puncture of the bladder.



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